

SCREENING A NEW TECHNOLOGY

by

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Submitted to the System Design and Management Program
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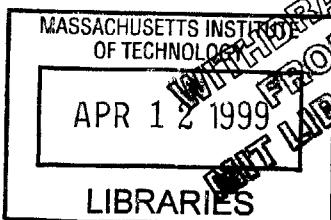
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ABSTRACT

A system dynamics model is presented for use as a generic tool for screening new technologies for diffusion into the market. The model is applicable in a wide range of markets, as it is adjustable for price, performance and brand sensitivities. The model is not intended to be an absolute predictor of success or failure for a new technology; rather, it serves as a tool to consider the merits of the new technology.

Using this model and embodied in a new product, a new technology may be evaluated by its relative competitive position measured in terms of its relative price, performance and brand valuation. The criteria for success or failure include net present valuation for the new product and its collateral opportunities as well as market share contributions as predicted over time.

The model considers the complex dynamics that exist between important technical and business factors. These critical factors include market growth rate, demand, risk, switching cost, product cost, price, brand, performance, market sensitivities and market timing. It also accounts for adverse effects such as cannibalization.

In addition, it is demonstrated that this model may be used for external assessment of the competitor's situation.

The model is designed to be generic and fully adjustable based on 88 inputs that include business case inputs, general inputs, lookup tables and simulation requirements.

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1 INTRODUCTION

Companies invest a considerable amount of resources searching for new technologies. The total national R&D expenditures for the United States for 1996 was \$194.72 billion (estimated non-defense R&D was \$160 billion)¹. In 1998, the R&D spending for GM, IBM, Lucent and HP was estimated to be \$8.63b, \$4.51b, \$4.77b and \$3.49b, respectively². Their goal is clear: new technologies lead to new and improved products; thus a better competitive and financial position for the company. However, while many companies realize positive growth in sales in direct correlation with their R&D investment growth, some clearly do not. Texas Instruments, Inc. had an estimated R&D spending of \$1.80b in 1998. This represented an R&D growth of 16.6%. However, their sales growth was -19.4%². This indicates that as exciting and promising as many new technologies may be, only a fraction of them become successful, where success of a new technology, here, is defined to be successful commercialization of a new product based on that technology and an expected market acceptance of the new product.

In 1986, Eastman Kodak Company acquired a new technology for capture of still video signals into digital data, and the subsequent transmission of the data to a remote sight for viewing. This technology was used in a new product called KODAK PREVIEW Electronic Imaging System. This product was intended for use in the Graphic Arts Industry allowing Art Directors to "soft-proof" graphic designs. The new technology promised to save time and cost by making the Art Director part of the design process and in real time. However, KODAK PREVIEW failed as a product and in 1989, Kodak stopped producing it.

This is but one example of how a new and exciting technology failed in the market and many interrelated factors contribute to this failure. First, the quality of the digital images was far below user's initial expectation. Digital images could not accurately convey the exactness of the color. Second, many potential users of this technology did not accurately predict the impact that this technology would have on their business and their workflow. At first, almost all of them hailed the new technology but as they learned more about the exact application, to Kodak's disappointment, they found themselves not ready to switch. Third, the cost of usage was higher than expected. Users had to pay a monthly fee for a special telephone line as well as for usage. Finally, the digital technology posed a challenge to Kodak's sales and support team who was more comfortable with analog devices and consumables.

Indeed if image quality and switching cost were not issues, cost would not have been an issue. Additionally, image quality played an important role in forcing the users to realize that there was a high switching cost and that it required them to devise more and different processes to finalize designs.

¹ *Statistical Abstract of the United States*, 1998, 118th Edition

² *R&D Ratios & Budgets*, Schonfeld & Associates, Inc., 1998, ISBN 1-878339-63-X

How did Kodak fail to predict this failure? After all, Kodak collected considerable information showing potential users were overwhelmingly in favor of this technology. The answer may be that they focused more on the technology than the product and that they failed to adequately predict the dynamics involved in users adapting such a new product.

Then, in general, what is the right balance of focus between technology and product? How can we better understand the dynamics involved in users adapting a new product? These are the questions that this work seeks to address. A system dynamics model is presented for use as a tool to quantify as best as possible, contributions that a new technology and its dependent new product can make towards its success. This model is not intended to be an absolute predictor of success or failure for the new technology; rather, it merely serves as a tool to consider, in a dynamic setting, the merits of a new technology. Ideally, when a new technology is available, the model should be used with a business case in hand as one of the final steps before proceeding with full commercialization. The business case should be for a new product that is based primarily on the new technology. As input, the model will require data from this business case, historical data related to the market being considered, and data collected from potential customers.

1.1 System Dynamics

Introduced by Professor Jay Forrester in 1958, System Dynamics is a methodology for modeling complex dynamic systems³. In general, system dynamics can be used to model any system, e.g. social, political, technical, managerial, financial systems. Grounded in control theory and the modern theory of nonlinear dynamics, system dynamics uses feedback loops, Level and Rate structures, time delays and non-linearities to model a system and the interactions among its components over time.

A number of software applications have been designed to use system dynamics as a modeling tool. Two of the most popular of these software applications are Vensim® by Ventana Systems, Inc.⁴ and ithink® by High Performance Systems, Inc.⁵.

For more information about system dynamics, reader is referred to writings of Ed Roberts⁶, John Morecroft and John Sternman⁷.

³ Forrester, J.W., *Industrial Dynamics*, MIT Press 1961

⁴ Ventana Systems, Inc., <http://www.vensim.com>

⁵ High Performance Systems, Inc., <http://www.hps-inc.com>

⁶ Roberts, E.B., *Managerial Applications of System Dynamics*, Productivity Press 1978

⁷ Morecroft, J.D.W. and Sternman, J.D., *Modeling for Learning*, Productivity Press 1994

1.2 Overview

The system dynamics model presented in this work is designed to help its user test readiness of a “new technology” for introduction into the market. This is achieved by focusing on a “new product” that is primarily based on this new technology and simulation of how the new product might perform in the market. The model requires 88 input variables that define a realistic environment in which the new technology and the new product have to be evaluated. These inputs describe the simulation requirements as well as all the technical and business factors that characterize the new technology, the new product and the market. Then, the performance of the new product is assessed against the performance of similar but existing products. Specifically, the model considers four (4) products:

1. The Existing Product – This is the main existing product for the company⁸ that is evaluating a new technology. The existing product uses an existing technology.
2. The Competitor’s Product – This is the main product that is offered by a competitor and competes against the existing product. Usually, it is based on the same or a similar technology as of the existing product.
3. The Other Products – This is the collection of other products in the market that use the same or similar technologies as of the existing product.
4. The New Product – This is the new product which will use the new technology. This is the product that is being evaluated along with the new technology.

As shown in Figure 1-1, in addition to the input variables, the principal components of the model include:

- Product Sales Performance: The key driving factor for the success of each product is its sales performance, which is characterized by the sales rate and the installed base for each product.
- Potential Demand: The potential demand represents the pool of sales opportunities for all products.
- Adjusted Factors: A set of factors determine how each product performs in the market. These factors which include price, performance, brand, risk and switching cost are dynamically adjusted according to the sensitivities of the market being considered.
- Commercial Value of the New Product: As one measure of success, the commercial value of the new product is measured in terms of its net present value. This represents one of the outputs of the model.

⁸ In general, all references to “the company” or “your company” act on the company that is screening the new technology. This same company owns the Existing Product and is considering commercializing and marketing the New Product.

- **Market Share:** Market share is another output of the model and it may be considered as another measure of success expressed in terms of the percentage of the installed base captured by the company through sales of the existing and the new products.
- **Output Variables:** All variables that are dynamically calculated by the model also serve as its output. Such variables are usually related to the sales performance of the new or the existing products.

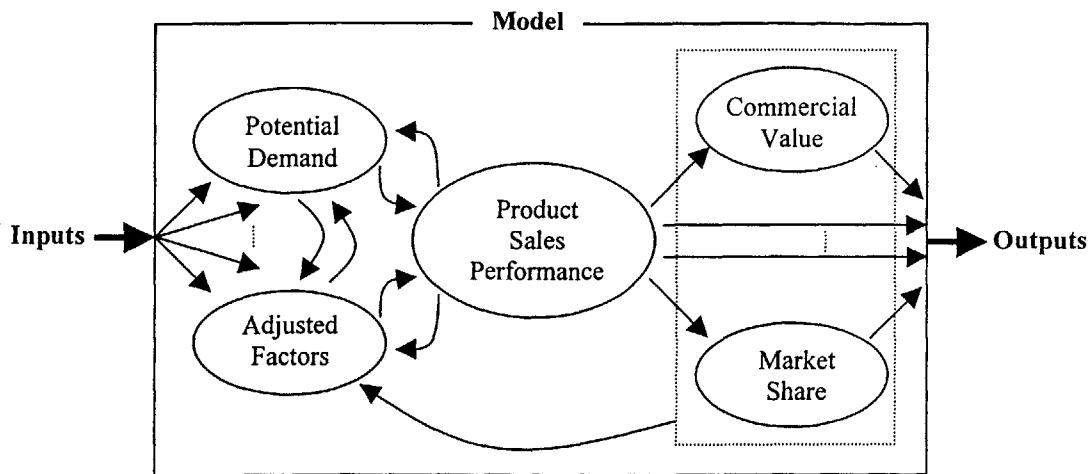


Figure 1-1. The Model and its Principal Components

A significant advantage of using system dynamics as the basis for the model is that it allows the components of the model to be inter-linked dynamically and over time. This point is illustrated by considering the following cases:

- Potential demand for a product is dynamically calculated based on the sales performance of all products and the adjusted factors at play in the market. This relationship is expressed by linking the replacement rate (a function of the total installed base) as a source for the potential demand, while indirectly, the adjusted factors determine the total installed base.
- The rate at which the new product is sold over the duration of the simulation is decided by the effect that factors like price, performance, brand, risk and switching cost have on the potential demand for the new product.
- Some factors are affected by the general performance of the product. For example, price of the new product is partly affected by its market share.

It must be noted that the model serves as a tool for learning more about the value of the new technology that is being evaluated. Such learnings are achieved by examining the simulation data, which includes:

- the rate at which the company's products sell,
- the change in the company's installed base,
- the competitive scene,
- the diverse effects of cannibalization (if any),
- the effects that price, performance, brand, risk and switching cost have on the demand for the company's products, and
- the net present value of the new product and its collateral opportunities.

Furthermore, the model gives the user subsequent opportunities to change some inputs and simulate the reaction of the market. Any input that is changed may be among those inputs that are under full control of the company (e.g. performance characteristics of the new product), or it may be an input that is not under the control of the company (e.g. price position for the competitor's product). This provides the user with a powerful tool to consider different "what if" scenarios and optimize the company's entry position.

1.3 Context

This section contains answers to several key questions about the model that is presented in this work:

Why should the model be used?

As exciting and interesting as a new technology may be, it presents nothing more than an option with a high degree of uncertainty. It is an option because it offers a manager a new possibility. However, it carries many uncertainties because the manager must decide how to proceed with this new technology. Should he or she commit resources and additional investments to develop a new product based on this technology? What would be the key features and added value for this new product? Is there a market for it? Is the market ready for it? How well does it match the company's core competencies? What is the competitive landscape? What are the risks? Is the timing right? Is there a window of opportunity? How likely is it for this new product to succeed? What is success?

Of course, these questions and their answers are interrelated and no one is able to see into the future and provide all the answers correctly. The current state of the affairs is such that these questions are more or less answered (and may be rated) independently. For example, managers may rely on focus groups and

customer surveys to define the features and performance of the new product. The results obtained from focus groups and customer surveys may be directly matched against the company's capabilities in a one-to-one relationship. How can engineering meet the performance sought by potential customers? How well can the company meet the potential customer's pricing requirements? How well will the product perform against the competition? Etc.

Unfortunately, the current state of the affairs leaves a lot of room for interpretation and ignores the dynamic relationship that these elements have among each other. For example, pricing is as much a function of what the customer is willing to pay as it is a function of the relative features of the product, its brand, the company's market share, manufacturing capacity and availability, the company's rate of return on investment, and the customer's switching cost. To consider pricing one must consider all these factors, and to consider each of these factors, one must consider other corresponding sets of factors. This makes for a huge task that is significantly underestimated by most managers.

Therefore, a tool that can dynamically link all technical and business factors together and predict their interplay would be a valuable tool. Such a tool would, in a generic sense, characterize the response of the market to the new technology and the new product. By utilizing such a tool, the manager can examine the effect of each factor be it technical, organizational or marketing. The manager will have a better grasp of the uncertainties that he or she faces. System dynamics provides us with such a tool and the potential to consider all these factors dynamically and over time. The model presented in this work intends to empower the managers to better evaluate new technologies and their potentials.

When should the model be used?

First, the following initial conditions are desired, although not completely required:

1. A "new technology" must be available – The underlying assumption made while developing the model is that new technologies present an interesting challenge. Generally, new technologies are interesting and tempting, but practically, they are risky. New technologies are almost always exciting because they provide new opportunities. They are tempting because of the new possibilities that they offer but also because of the investment that has already been made towards creating them. Finally, they are risky because the newness carries with it a high degree of uncertainty. All this – the excitement, the temptation and the uncertainty – calls for a tool to evaluate the new technology objectively.
2. A "new product" must be considered that is primarily based on the new technology – The new technology manifests itself through a new and improved product. This new product requires as much evaluation as does the new technology. The same tool may be used to evaluate the new product and reach a decision about its commercialization.

3. A product concept must be selected – The tool does not help in conceptualizing a new product but it helps in its evaluation. Therefore, the initial work must be done to have a product concept on hand for evaluation.
4. A business case must be available – The tool requires information about the target market, product features, fixed and variable costs, pricing, competition, etc.

Once the initial conditions are met, the model will have utility in being used as a tool. To be more specific, consider Figure 1-2, which shows a typical process for product development⁹. This process includes five phases briefly described as follows:

1. Concept Development – This phase involves evaluation of product concepts for targeted market segments. Lead users and competitive products are identified in this phase. Also, manufacturing cost is estimated in phase 1. This is a critical phase because it is often the basis for a commitment to a full-scale development and design program.
2. System-Level Design – At this point, a serious commitment is made to a budget, schedule and project team. In this phase, the product architecture and its major subsystems and interfaces are defined.
3. Detail Design – As the name suggests, in this phase, the product is designed in detail with complete specification of geometry, materials, and tolerances.
4. Testing and Refinement – Preproduction versions of the product are made, tested and refined. Also, preparations are made for launch of the product.
5. Production Ramp-Up – Early production versions of the product are evaluated and systematically, the entire production system begins operation.

As suggested in Figure 1-2, the new technology and the new product that is primarily based on this new technology should be evaluated in the early stages of the product development process. In fact, entry into phase 2 and any serious commitment to a full-scale program should hinge on the categorical success of this evaluation.

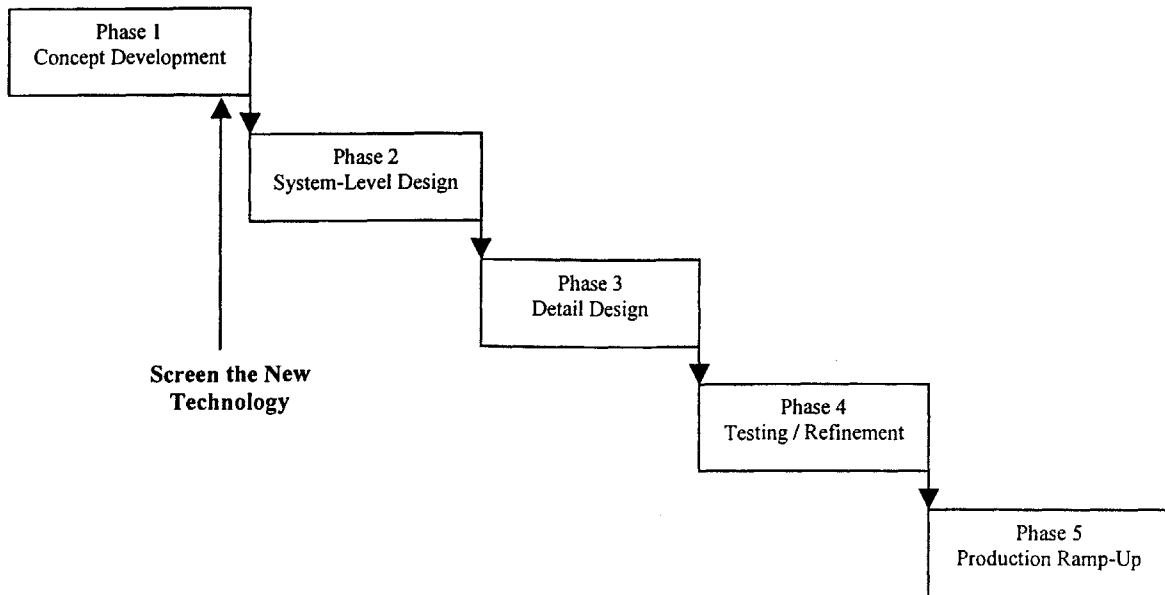


Figure 1-2. A Generic Development Process

Who should use the model?

The model requires both business and technical competency in providing input and analysis. Therefore, a team should be formed consisting of business and technical people.

⁹ Ulrich, Karl T. and Eppinger Steven D., *Product Design and Development*, McGraw-Hill, Inc., 1995. ISBN 0-07-065811-0.

2 METHODOLOGY

The approach used for designing the model is described in this chapter. First, there is a general discussion on the appropriateness of evaluating a new technology through evaluation of a new product that is primarily based on that new technology. Second, the approach for designing the model is described in detail. Then, there is a discussion on how market sensitivities are pertinent to this model. Finally, the criteria for success for the new technology are discussed.

2.1 A New Product vs. A New Technology

As it may be obvious, to examine, study and evaluate a new enabling technology for its potential commercial value, one must also examine, study and evaluate the new products that are primarily based on this new technology. By itself, a new technology is valuable only as an intellectual property. It follows that in almost all cases, what is more important is the commercial value that a new technology can unleash. The intellectual property value of a new technology directly depends on the commercial value of the new products that use that technology. The more such products sell the higher the commercial value and thus, the higher the intellectual property value of the enabling technology.

For example, invented by Philips, the new audio CD technology paved the way for new audio systems. As a product, a CD player is primarily based on the new audio CD technology. At the high level, the CD player, like its predecessors, Cassette Tape or LP players, is partly used for playing music – it serves the same need as its predecessors served. However, the CD player is arguably recognized as a better product than its predecessors because of the clarity of sound that it offers. This example illustrates first that the CD technology is the enabling technology, without which CD players would not have existed. Also, CD players generate the commercial value that consumer electronic companies seek, while the CD technology has value as an intellectual property that benefits Philips. Without the commercial value, the intellectual property value would have been limited.

In conclusion of this section, a new technology must be recognized as an enabling necessity for new and improved products. Its success depends on how well it can be implemented in new products and ultimately, how well the new products sell. Therefore, as stated before, the complete examination of a new technology requires forethought into its dependent new products.

2.2 Technology Screening

When it is used in a product, to some degree, the new technology becomes transparent to the user as the features and performance of the product become more apparent. The underlying new technology helps in

differentiating a product but the product itself becomes the main determining factor for the commercial value for a company.

Figure 2-1 is a graphical representation of how this work intends to evaluate a new technology.

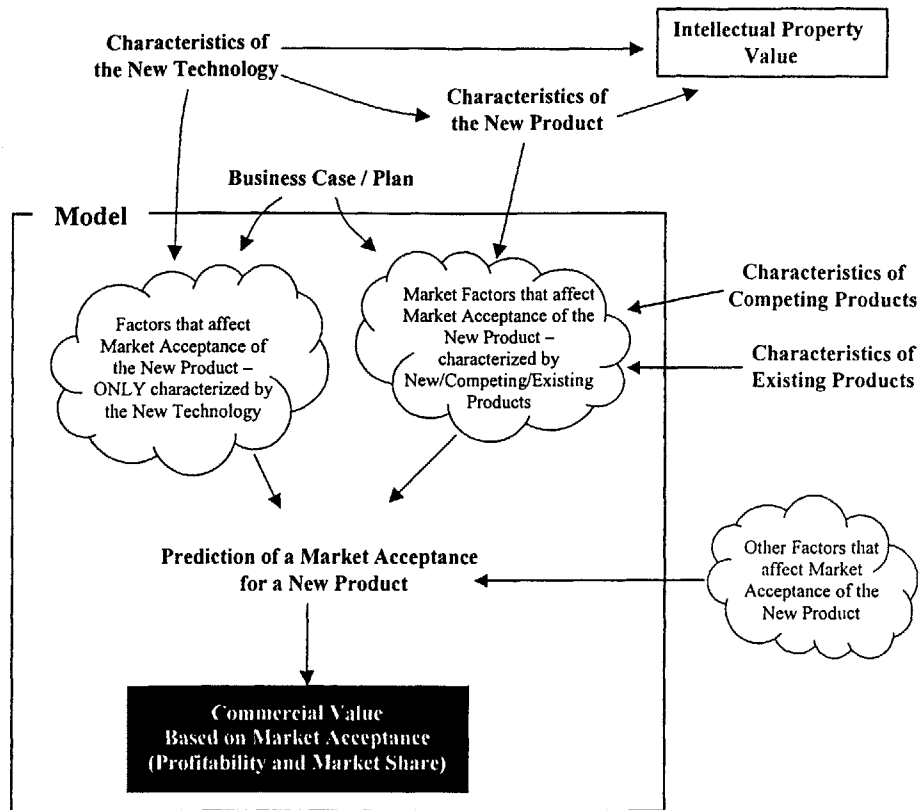


Figure 2-1. Technology Screening Roadmap

Given a new technology, a new product is envisioned that is primarily based on the new technology. It is assumed that a business case is on hand for the new product. Furthermore, existing and competing¹⁰ products as well as the market are considered and characterized. These form a set of inputs for the model discussed in this work. The purpose of the model is to predict how well the new product will be accepted in the market. In general, the commercial value generated by marketing the new product, and as expressed in terms of market share and profitability act as measures of this success. However, the user is free to use any output generated by the model as an alternative measure of success or a deciding factor. The criteria for success for a new technology are a critical consideration and they will be discussed more in detail later.

¹⁰ "Existing Product" means a current product similar in nature to the New Product, but based on an existing technology. In most cases, marketing of the New Product leads to cannibalization or replacement of the Existing Product. Likewise, a "Competing Product" means current products similar in nature to the New Product and based on existing technologies, but offered by competitors.

Factors that will be considered during the characterization of the elements discussed above are listed comprehensively in Table 2-1 followed by a brief discussion on each.

Table 2-1. Comprehensive list of factors that affect market acceptance of the New Product

Factors Considered	Characterized by		
	New Technology	Products	Market
1. Features/Performance/Reliability	✓	✓	✓
2. Research Capabilities	✓		
3. Development/Design/Mfg.	✓	✓	
4. Sales/Support/Channel		✓	✓
5. Brand		✓	✓
6. Patent Position	✓	✓	
7. Switching Cost/Network Externalities		✓	
8. Consumer Taste		✓	
9. Price		✓	
10. Cost of Mfg./ Capital Investment	✓	✓	
11. Volume/Market Size			✓
12. Cannibalization		✓	
13. Competing Technologies	✓	✓	
14. New Applications/Opportunities	✓		
15. Risk	✓	✓	
16. Regulations	✓	✓	
17. Timing	✓	✓	
18. Company Strategy/Direction	✓	✓	
19. Market Sensitivities			✓

1. Features / Performance / Reliability: Features, performance and reliability of the new product may be as much determined by the market requirements through existing and competing products as it may be influenced by the new technology. This sets the basis for one-to-one comparisons between the new product and the existing or the competing products. Market acceptance of the new product and the

new technology may heavily depend on the new product having to far outperform the existing and competing products.

2. Research Capabilities: In as much as research precedes the new technology, it will not play a big role in market acceptance of the new product. However, goodness of research could play a significant role in the successful commercialization of the new product. Therefore, this is a risk factor more than anything else.
3. Development / Design / Manufacturing Capabilities: Given a new technology and a vision for a new product, development, design and manufacturing capabilities of the company become crucial for effective delivery of the new product. This is a risk factor, which is characterized by both the new technology and the new product.
4. Sales / Support / Channel Capabilities: Once the new product is available, one of the next important factors in market acceptance of it is the company's ability to reach and support the market. At this stage the company needs the ability to effectively market, sell, distribute and support the new product. This too is a risk factor but it relates to market norms and how well the new product fits the company's capabilities in sales, support and distribution.
5. Brand: The more customers favorably recognize the company's brand the better are the chances for the new product to be accepted in the market. This is a powerful factor especially in brand-sensitive markets.
6. Patent Position: A strong patent position can play an important role in weakening the competitor's position. In this work, this advantage could manifest itself as a feature and performance advantage relative to competing products.
7. Switching Cost / Network Externalities: Switching cost can play a powerful role in the end-user's mindset in deciding to adapt a new product that is based on a new technology by switching from an existing product that is based on a known and existing technology.

Such costs can be direct and indirect, and positive and negative. Direct costs may include but are not limited to costs associated with installation of the new product, removal of any old products, and training. Indirect costs are associated with but not limited to possible loss of productivity during switching, which may result in loss of customers and/or sales for the end-user. Indirect cost may rise when there is requirement that a large subset of the market have to adapt the new technology before it could be considered worthwhile (e.g. facsimile). It is very important to point out that many factors contribute to this cost and most of them are very subtle.

The direct and indirect costs listed above are negative costs – they discourage the end-users to switch to the new product and the new technology. A positive switching cost is the opportunity cost makes the end-user feel left out if he/she does not switch to the new product and the new technology – the opportunity cost works in favor of the new product.

8. Consumer Taste: A higher degree of correlation between the feature and performance set of the new product and the end-user's taste leads to a higher chance that the new product be successfully adapted by the market. This is independent of the competitive stance of the new product in terms of features and performance against competing products.
9. Price: Price is an obvious factor in market acceptance of any product especially in price-sensitive markets.
10. Cost of Manufacturing / Capital Investment: These are consideration in the business case for the new product and as such are considered important factors in success of the new product.
11. Volume / Market Size: Another consideration in the business case of the new product, market size and the potential volume determine the upper limit for the commercial success of the new product.
12. Cannibalization: A new product based on a new technology may lead to the premature displacement of a profitable existing product based on a stable technology. As such, cannibalization is an important factor in determining the overall success of the company.
13. Competing Technologies: As manifested in competing products, competing technologies can influence the success of the new product.
14. New Applications / Opportunities: It is likely that a new technology can pave the way for new applications and new opportunities. These are applications and opportunities that are not readily available for the products that are based on existing technologies. Such new applications and opportunities contribute positively to the success of a new technology and possibly, to the success of the new product. For example, CD technology allows CD players to be used with both audio CDs for musical applications and data CDs for computer applications.
15. Risk: This is a collection of those factors that may jeopardize the success of the new product in its life cycle. Here, risk factors associated with the new technology as they influence commercialization and supply of the new product are of interest.
16. Regulations: Due to the nature of the new technology it uses, the new product may require meeting new regulatory approvals that may jeopardize schedule and/or cost of the new product. This is a risk factor.

17. Timing: Schedule for the availability of the new product as it may be influenced by the new technology is an important risk factor for its success.
18. Company Strategy / Direction: At best, a new technology must support and be supported by the core competencies of the company. Any deviation from this rule must be considered a risk threatening the success of the new product.
19. Market Sensitivities: Sensitivity of the market to price, brand or performance can affect the success of the new product. One of the basic requirements for success of a new product is that it must meet the market needs. If the new technology is expensive to produce and the market is price-sensitive, the new product is very likely to fail. Therefore, market sensitivities must be considered when a new product is being evaluated. This consideration must be focused around the new technology that is used in the new product.

The next step in the process is to classify the above factors into a few and more manageable list, and to develop a framework where they can be applied to a system dynamics model for purpose of screening a new technology. As shown in Figure 2-2, this framework will focus on four types of products:

1. The new Product – This is the new product that is primarily based on the new technology, which is being evaluated.
2. The Existing Product – This is an existing product in the company's portfolio, which is similar in nature to the New Product, but is based on an existing technology. The existing product is being considered mainly because marketing of the new product may lead to cannibalization or replacement of the existing product.
3. The Competitor's Product – This is the main product in the market that the new product intends to compete against. It is similar in nature to the new product, but like the existing product, it is based on an existing technology.
4. Other Products – These are all other similar products in the market but are not of major concern.

As shown in Figure 2-2, a reduced number of factors predict the market acceptance for the new product, the existing product and the competitor's product. Market acceptance for the other products is estimated using a historic ratio of the combined market share of the existing and competing products.

Success is measured by calculating the predicted overall net present value of the new product. However, this measure of success is not the only useful one. Behaviors of different elements of the model at different times in the simulation yield valuable insights.

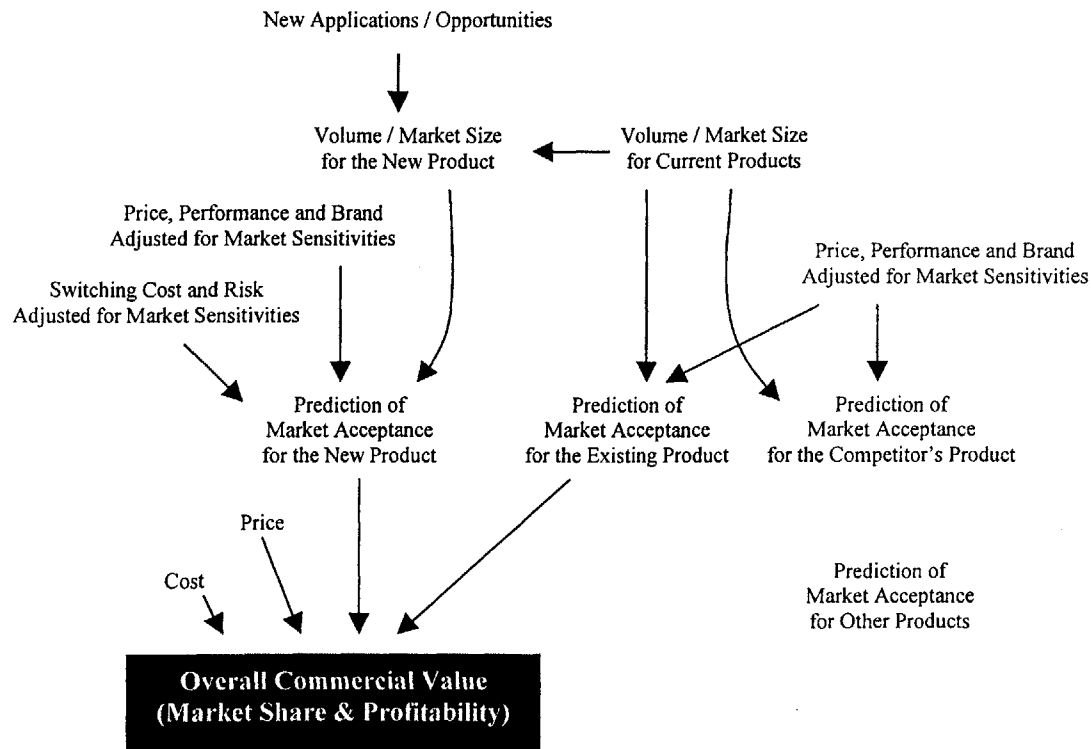


Figure 2-2. Outline for Screening Model

Table 2-2 contains the reduced list of factors and their descriptions.

Table 2-2. List of factors considered in this work

Performance Features/Performance/Reliability, Patent Position, Consumer Taste and Competing Technologies are combined into one class of factors called Performance. At user's discretion, five most important performance characteristics will be compared relative to the New Product, the Existing Product and the Competitor's Product. The results are adjusted for

Market Sensitivities and applied to the products.

Brand	Relative value of Brand between the company and the competitor will be quantified. The results are adjusted for Market Sensitivities and applied to the products.
Price	Relative contribution of product pricing will be dynamically measured. The results are adjusted for Market Sensitivities and applied to the products. Unit prices will be used to measure the overall commercial value of the new and existing products.
Switching Cost	Switching Cost is dynamically quantified and after adjusting for Market Sensitivities, it is applied to the new product only.
Risk	Overall Risk is quantified over time and after adjusting for Market Sensitivities, it is applied to the new product only. Elements of risk may include other factors like Research Capabilities, Development / Design / manufacturing Capabilities, Sales / Support / Channel Capabilities, Regulations, Timing, Company Strategy / Direction.
Volume / Market Size	This factor will be dynamically calculated and applied to the products.
New Applications/Opportunities	This factor will be applied to the new product increasing the Volume / Market Size for the new product.
Cost	Unit costs will be used to measure the overall commercial value of the new and existing products.
Market Sensitivities	These factors will be applied to Performance, Price, Brand, Switching Cost and Risk as appropriate.
Cannibalization	This factor will be considered as the new and the existing products are compared in the model.

2.3 Market Sensitivities

The model presented in this work considers the following market sensitivities for the new and the existing products:

➤ For the new product:

- Price: The effect of price on the demand for the new product is weighted based on the market's sensitivity towards price. This weighs the market's sensitivity to the price of the new product.
- Performance: The effect of performance on the demand for the new product is weighted based on the market's sensitivity towards performance. This weighs the market's sensitivity to the relative performance of the new product.
- Brand: The effect of brand on the demand for the new product is weighted based on the market's sensitivity towards brand. This weighs the market's sensitivity to the brand of a new product.
- Risk: The effect of risk on the demand for the new product is weighted based on the market's sensitivity towards risk. This weighs the market's sensitivity to the company's risk in effectively introducing the new product to the market.
- Switching Cost: The effect of switching cost on the demand for the new product is weighted based on the market's sensitivity towards switching cost. This weighs the market's general sensitivity towards direct and indirect costs involved in switching from existing products to new products.

➤ For the existing products:

- Price: The effect of price on the demand for the new product is weighted based on the market's sensitivity towards price. This weighs the market's sensitivity to the price of the existing products.
- Performance: The effect of performance on the demand for the new product is weighted based on the market's sensitivity towards performance. This weighs the market's sensitivity to the relative performance of the existing products.
- Brand: The effect of brand on the demand for the new product is weighted based on the market's sensitivity towards brand. This weighs the market's sensitivity to the brand of the existing products.

In each case, the user specifies the weight factor, which can change linearly over time. Expressed in terms of percentages, the weight factors for the new product must add up to 100. Similarly, the weight factors for the existing product must add up to 100.

2.4 Criteria for Success

When considering commercialization of a new product, Net Present Value (NPV) is typically accepted as the ultimate criterion for its success. NPV is calculated by taking the present value of the expected revenue stream that the new product will generate and subtract the present value of the stream of expenditures required carrying out the project and manufacturing the product. This method requires that a discount rate be applied to the revenue and expenditure streams. Products with a positive NPV are expected to succeed.

However, as a purely quantitative measure, the NPV method tends to ignore the “strategic value” of the new product, which may be categorized as follows:

A. Options Approach¹¹: Based on an analogy with financial options, a company with a new technology and a new product concept holds an “option”, which is simply an opportunity to invest. The company is holding something much like a financial call option. It has the right but not the obligation to commercialize the new product and gain entitlement to its expected stream of profits. Viewing an investment decision from this point of view enables a decision-maker to:

- Examine the new product as an opportunity,
- Determine what portion of the investment, if any, can be recovered if market conditions change,
- Consider any uncertainties around the new technology, product commercialization or the market,
- Consider the timing to decide whether product commercialization should be delayed or not, and in general,
- Use discretion in exercising the option.

In contrast with the NPV method, which requires only a positive NPV to go forward with product commercialization, the options approach requires the NPV to be higher than the option value. This option is inherently valuable because it provides the company with the possibility of waiting for new

¹¹ Dixit, Avinash K. and Pindyck, Robert S., “The Options Approach to Capital Investing”, Harvard Business Review, Reprint 95303, May-June 1995.

information about the market conditions. Once the commercialization project is undertaken, the option is exercised and the company gives up the possibility of waiting for any new information.

- B. Organizational Capabilities^{12 13}: The decision to invest in a new product may be regarded as an investment in organizational capabilities. In contrast with myopic investments that are highly biased towards short-term investments, this type of investment is more aligned with the company's long-term strategy to invest in its future. Organizational capabilities relate to a wide spectrum of qualifications: creating quality, being more flexible, responding to market quickly, and being more innovative. Organizational capabilities make it possible for a company to exploit the market opportunities more effectively. Therefore, despite the NPV calculated for a new product, a company might choose to proceed with its commercialization to enhance its organizational capabilities.
- C. Collateral Opportunities: The strategic value of the new product may be realized in terms of incremental sales of additional products and services. For example, Gillette's MACH3 razor, as a product, does not justify \$750 million investment in development and manufacturing capital¹⁴. The justification comes from the potential of profiting from sales of new cartridges. This case transcends the NPV or the commercial value of a new product as a self-contained product, and considers sales of additional products and services.
- D. Intellectual Property: Intellectual property, as it relates to a new technology, is recognized as a valuable asset; however, this work will not consider it as an overall success factor for the new technology. It may influence the success of the new product as a competitive advantage but it is not measured separately. User will make this a separate consideration outside of the modeling technique presented here.
- E. Market Share: Market share, and not commercial value, may be an important deciding factor to commercialize a new product. In those cases where increased market share and market presence is important to a company, a promising new product has a high strategic value despite its expected NPV.

Also, as an alternative to not doing anything and risking possible erosion of its current market share, a company may choose to go forward with its plans for a new product. Again, the new product may not hold any promise of positive return on investment, but strategically, it may help the company avoid surrendering market share to competition.

¹² Baldwin, Carliss Y. and Clark, Kim B., "Capabilities and Capital Investment: New Perspectives on Capital Budgeting", *Journal of Applied Corporate Finance*, Vol. 5, No. 2, Summer 1992.

¹³ Kogut, Bruce and Kulatilaka, Nalin, "Options Thinking and Platform Investments: Investing in Opportunity", *California Management Review*, Vol. 36, No. 2, Winter 1994.

¹⁴ Gillette Corporate News, June 26, 1998.

The strategic value of a new product alongside its net present value determines its success criteria. The system dynamics model presented in this work quantifies the following:

1. The net present value for the new product: NPV is calculated by taking the present value of the expected stream of profits that the new product will generate and subtract the present value of the new product commercialization and its related capital investments. NPV serves as the most typical measure of success for the new product. It can easily be measured because the anticipated sales rate for the new product as well as its unit price and unit cost are available as part of the simulation. The discount rate¹⁵ used for this calculation is available as an input into the model.

A positive NPV is an indication that the new product is likely to succeed, and therefore, the company should consider undertaking the task of commercializing it.

2. The net present value from sales of additional products and services: This represents the NPV for the collateral opportunities tied to the new product. It is calculated based on the profits generated by sale of products and services made possible only by the availability of the new product. This is usually applicable to cases where the new product is leveraged to sell consumables, e.g. camera leveraged to sell film or razors leveraged to sell razor blades.

An overall positive NPV for the new product and its collateral opportunities is likely to justify commercialization of the new product.

3. The overall market share of the company: This is a measure of the company's market share based on the total installed base captured by the existing and the new products. This measure is expressed in terms of the percentage of the company's installed base in the market.

The overall market share may have a strategic value despite a negative overall NPV for the new product and its collateral opportunities. However, ideally, a positive overall NPV and a respectable gain in the market share is a definite vote for commercialization of the new product.

The model does not include a quantitative measure of success based on options value, organizational capabilities and intellectual property. Nonetheless, the user is encouraged to independently qualify the success of the new product based on these strategic value measures.

As an opportunity for enhancing the model presented in this work, one may include the "option value" of the new product when calculating its NPV.

¹⁵ The choice of the discount rate is very critical and its importance should not be understated. However, any discussion on this subject was judged to be beyond the scope of this work.

Furthermore, an interesting subject for further research would be a comparison between net present valuation as a measure of success for new technologies or products in contrast to strategic valuation. For example, such a research undertaking questions the current common practice where a NPV higher than zero is often enough to justify commercialization project. It will consider including the option value of the new product as a success measure; i.e. commercialization will be justified if NPV is higher than the option value.

3 MODEL

The main contribution of this work is a system dynamics model for use as a generic tool for screening new technologies as a test of readiness prior to commercialization. This model was produced using Vensim DSS32 version 3.0B. The model is a simulation of many interrelated product and market factors over time. Actual time step and duration used for the simulation are described in detail in chapter 4, Usage Recommendations. The model diagrams and documentation are attached as Appendices A and B, respectively. The model consists of 13 views, all of which are thoroughly described in this chapter.

3.1 Main

As shown in Figure 3-1, the Main View represents the highest level of the model. It is centered around four (4) products:

1. The Existing Product – This is the main existing product for the company that is evaluating a new technology. The existing product uses an existing technology.
2. The Competitor's Product – This is the main product that is offered by a competitor and competes against the existing product. Usually, it is based on the same or a similar technology as of the existing product.
3. The Other Products – This is the collection of other products in the market that use the same or similar technologies as of the existing product.
4. The New Product – This is the new product which will use the new technology. This is the product that is being evaluated along with the new technology.

Elements of this view are described below.

3.1.1 Potential Demand

Potential Demand is the pool of sales opportunities for all products. Expressed in terms of units per year, it is determined by the Replacement Rate and the Expected Market Growth rate (see Figure 3-1). The Replacement Rate is a general input to the model and it is based on the average rate of replacement of units in the market.

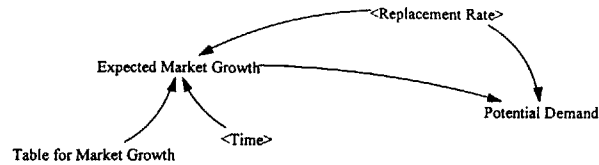


Figure 3 - 1. Potential Demand

Also, based on the Replacement Rate, the Expected Market Growth is really an estimate of how the market is expected to grow over time. As a general input to the model, the Table for Market Growth indicates the estimated growth by a desired percentage of the Replacement Rate every year for the duration of the simulation.

3.1.2 Incremental Demand for the New Product

The Incremental Demand for the New Product is the added demand realized due to the new applications and uses made possible by the new technology. These are applications and opportunities that are not available or conceivable for the products that are based on existing technologies. For example, CD technology allows CD players to be used with computer applications as an extension to their normal use with audio applications, whereas, the application for the old LP technology was limited to audio applications.

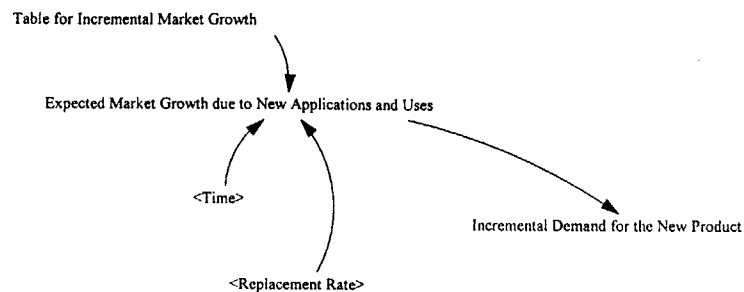


Figure 3 - 2. Incremental Demand for the New Product

As shown in Figure 3-2, the mechanism for determining the Incremental Demand for the New Product is similar to that of the Potential Demand. It is based on the Replacement Rate and the Expected market Growth due to New Applications and Uses.

3.1.3 Potential Demand for the New Product

As shown in Figure 3-3, the Potential Demand for the New Product consists of the Potential Demand plus the Incremental Demand for the New Product. Naturally, if the new technology offers new applications and uses, the potential for sales for the new product will be higher than the existing products.

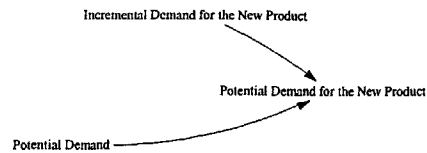


Figure 3 - 3. Potential Demand for the New Product

3.1.4 The New Product

Sales for the New Product draw from the Potential Demand for the New Product (see Figure 3-4). Where the ultimate limit of Sales Rate for the New Product is equal to the Potential Demand for the New Product, in reality, factors including price, performance, brand, risk, switching cost and availability reduce the sales rate to a fraction of that potential demand.

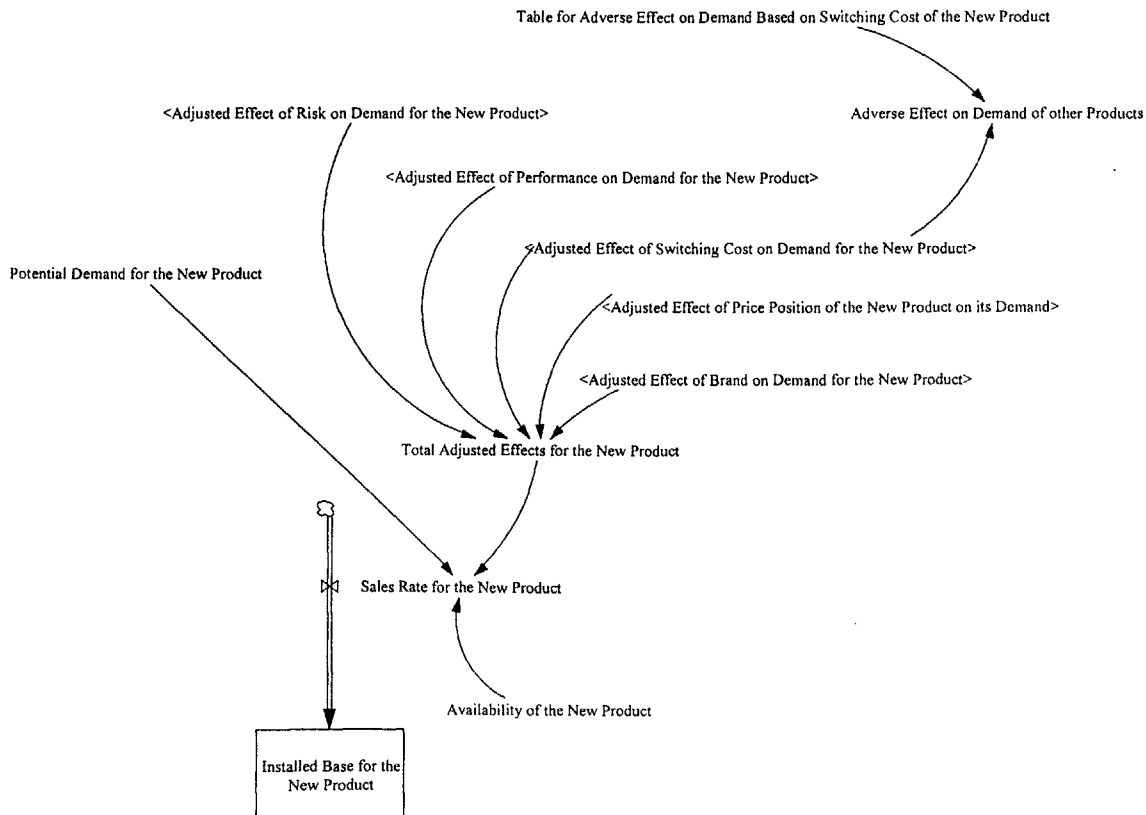


Figure 3 - 4. The New Product

If Potential Demand for the New Product after being adjusted by the effects of price, performance, brand, risk and switching cost is higher than Availability of the New Product, then Availability of the New Product puts a hard limit on sales. Otherwise, sales will only be limited to how much price, performance, brand, risk and switching cost affect it. Each factor is, in fact, a multiplier to the Potential Demand for the New Product. They will all be analyzed later; however, it is important to point out that these effects do not necessarily work in the direction of reducing the sales (by being a multiplier less than 1). For example, a favorable brand may actually help the sales by being a positive multiplier – positive in the sense that it can be greater than one.

As shown in Figure A-1, in more detail, the Installed Base for the New Product is depleted at the Replacement Rate for the New Product. The Replacement Rate for the New Product is a function of the Average Replacement Time.

Sales Rate for the New Product is expressed in terms of units per year. It feeds a level called “Installed Base for the New Product”. This and other installed bases will be analyzed in detail later.

3.1.5 The Existing Product

While tempered by the effects of price, performance, brand and availability, the Sales Rate for Your Existing Product draws from the Potential Demand (see Figure 3-5). This sales rate is also affected by the Adverse Effect on Demand of Other Products. The Adverse Effect on Demand of Other Products is a factor determined by the popularity and acceptance of the new product and the new technology. If switching cost for the new product is reduced and it becomes more popular, it will have an adverse effect on the sales of the existing and the competitor’s products. Of course, the user has the means to define the exact amount of adverse effect, if any.

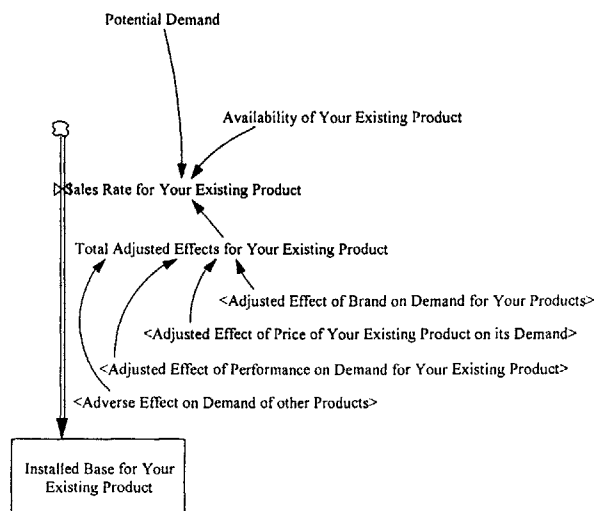


Figure 3 - 5. The Existing Product

The effect of Availability of Your Existing Product on the sales rate is similar to that described in the case of the new product.

Sales Rate for Your Existing Product is expressed in terms of units per year. It feeds a level called "Installed Base for Your Existing Product". This and other installed bases will be analyzed in detail later.

It is assumed that risk and switching cost are not major contributing factors for products based on the existing technology, while the new product is highly susceptible to both risk and switching cost due to the new technology it uses.

As shown in Figure A-1, in more detail, the Installed Base for Your Existing Product is depleted at the Replacement Rate for Your Existing Product, which is a function of the Average Replacement Time.

3.1.6 The Competitor's Product

Similar to the existing product, the Sales Rate for the Competitor's Product is moderated by the effects of price, performance, brand, availability and adverse effects (see Figure 3-6). Also similar to the existing product, the Sales Rate for the Competitor's Product draws from the Potential Demand.

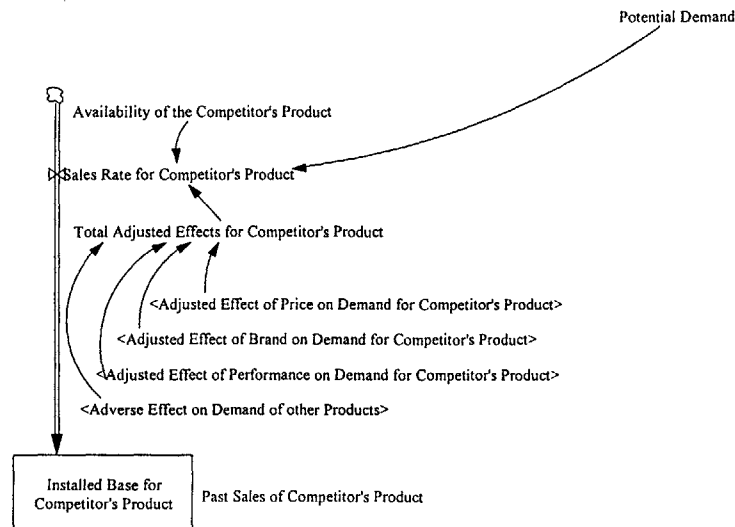


Figure 3 - 6. The Competitor's Product

Sales Rate for the Competitor's Product is expressed in terms of units per year. It feeds a level called "Installed Base for the Competitor's Product". This and other installed bases will be analyzed in detail later.

As the competitor's product is based on an existing technology, it is assumed that risk and switching cost are not major contributing factors to its sales rate.

As shown in Figure A-1, in more detail, the Installed Base for Competitor's Product is depleted at the Replacement Rate for Competitor's Product, which is a function of the Average Replacement Time.

3.1.7 Other Products

The model assumes that the balance of demand not satisfied through sales of the new, existing and competing products is sold as other products (see Figure 3-7).

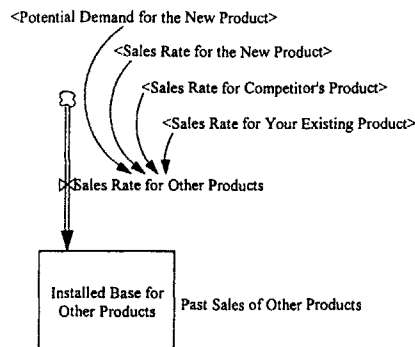


Figure 3 - 7. Other Products

As shown in Figure A-1, in more detail, the Installed Base for Other Products is depleted at the Replacement Rate for Other Products, which is a function of the Average Replacement Time.

3.2 Price

In general, Unit Price for the New Product is determined dynamically by the model. However, the model assumes that unit prices for the existing and competing products have settled to fixed prices. This assumption ignores the possibility of the competitor lowering prices and essentially, taking up a harvesting strategy when faced with a new product in the market. Thus, this may be a possible flaw in the model.

Unit Price for the New Product is based on the Indicated Unit Price for the New Product, which in turn is based on a variety of factors as explained below.

3.2.1 Desired Unit Price

As shown in Figure 3-8, Desired Unit Price is based on three factors: Desired Unit Price Based on (desired) Margin (based on cost), Desired Unit Price Based on Competitive (price) positioning, and Minimum (desired) Unit Price. For exact formulation, please refer to the model documentation attached as Appendix B.

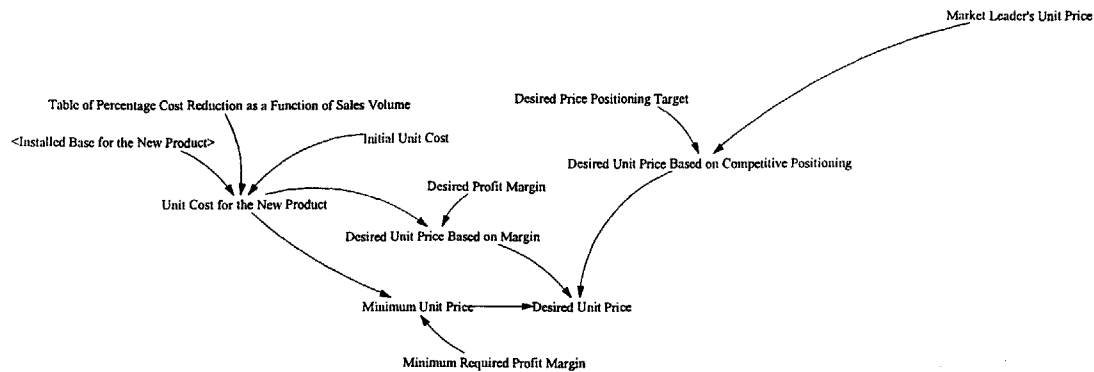


Figure 3 - 8. Desired Unit Price

3.2.2 Indicated Unit Price

As shown in Figure 3-9, Indicated Unit Price is the Desired Unit Price after being adjusted for effects of:

- Shortage/Surplus – The price tends to rise when there is a shortage of the new product.
- Market Share – Price tends to fall when there is a low market share.
- Relative Performance – Price tends to fall when the new product does not perform as well as competing products.
- Brand – Price tends to fall when its brand is not well recognized.

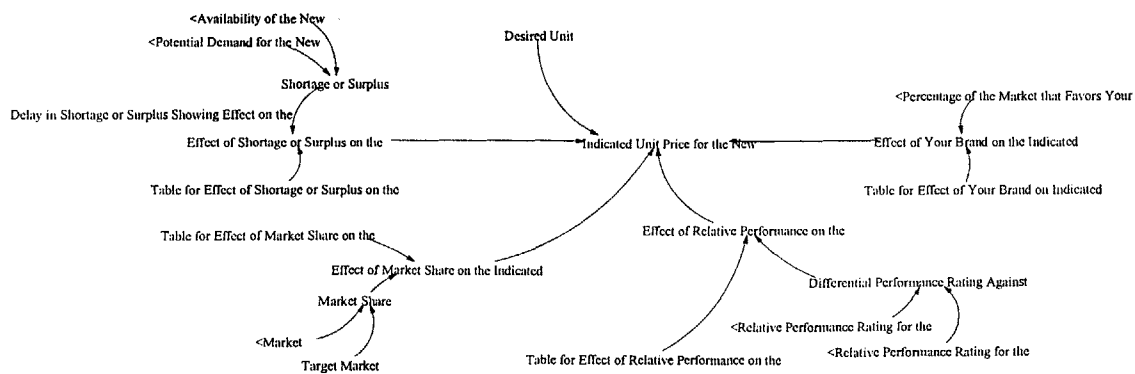


Figure 3 - 9. Indicated Unit Price

One of the benefits of system dynamics modeling is best evident in this area of the model. Note that demand and availability affect shortage or surplus, which in turn affect price, which in a feedback loop affects demand. The dynamics described here is virtually unparalleled.

3.2.3 Unit Price for the New Product

Finally, Unit Price for the New Product is determined based on the Indicated Unit Price for the New Product. Here, the model allows a final check for the absolute Minimum Unit Price permissible. This check is based on the company's policy for selling below this minimum price. If the Sell Below Minimum Unit Price Policy flag is zero, the Unit Price for the New Product will not fall below the minimum price.

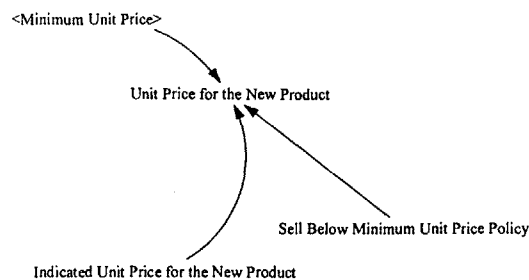


Figure 3 - 10. Unit Price for the New Product

3.2.4 Effects of Price

As shown in Figure 3-11, the effects of price on demand of the products are based on a comparison with the Market Leader's Unit Price. These effects are determined by the Table for Effect of Price Position on its Demand.

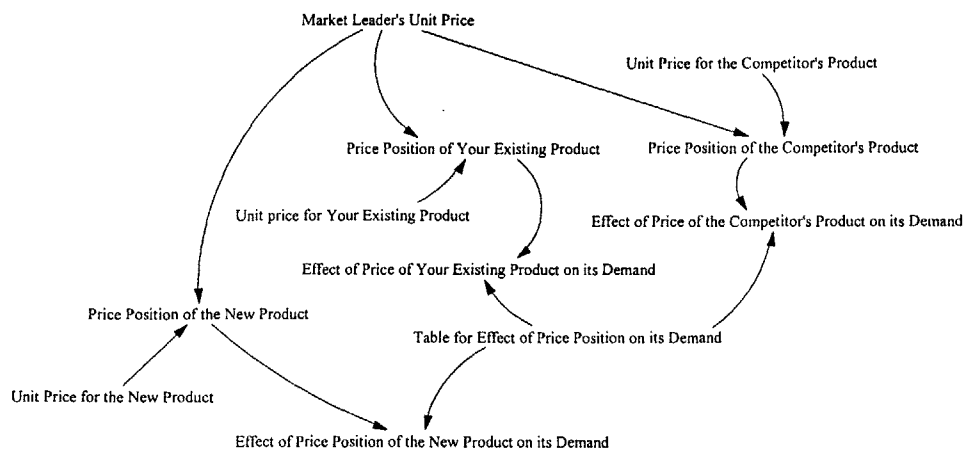


Figure 3 - 11. Effects of Price

3.3 Performance

The model allows the user to identify five (5) performance criteria relevant to the products that are being evaluated. The effect of performance on demand of each product is measured as described below.

3.3.1 Effect of Performance on Demand for the New Product

The new product is rated from 1 (Strongly Disadvantaged) to 5 (Strongly Advantaged) for each of the five performance criteria. These ratings are relative to the existing and competing products. As shown in Figure 3-12, each performance criterion is weighted by its relative importance. Finally a lookup table is used to quantify the contribution of each performance criterion to the overall effect on demand.

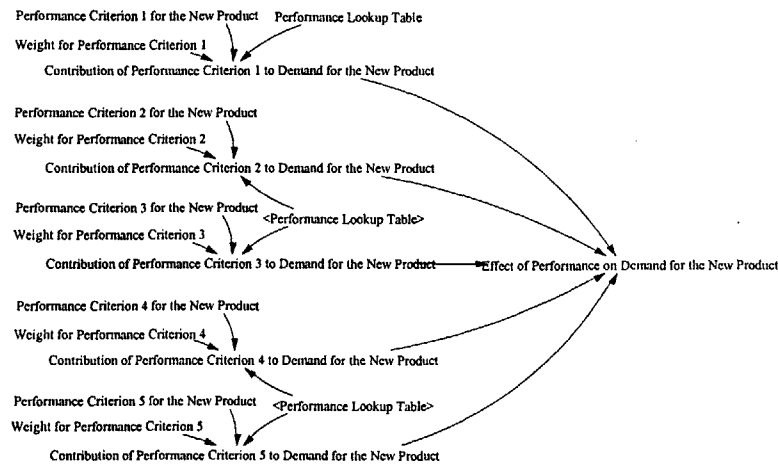


Figure 3 - 12. Effect of Performance on Demand for the New Product

3.3.2 Effect of Performance on Demand for Your Existing Product

Figure 3-13 shows a similar treatment for the existing product.

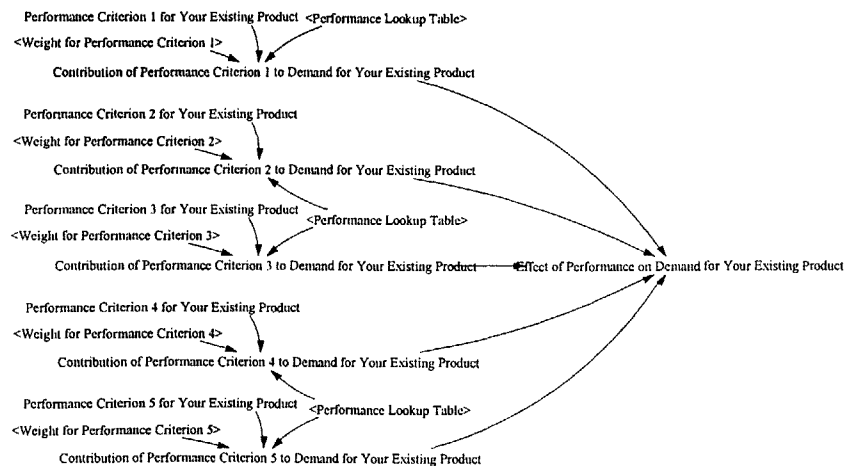


Figure 3 - 13. Effect of Performance on Demand for Your Existing Product

3.3.3 Effect of Performance on Demand for Competitor's Product

Similarly, Figure 3-14 shows that the Effect of Performance on Demand for Competitor's Product is determined using the same mechanism that was used with the new and existing products.

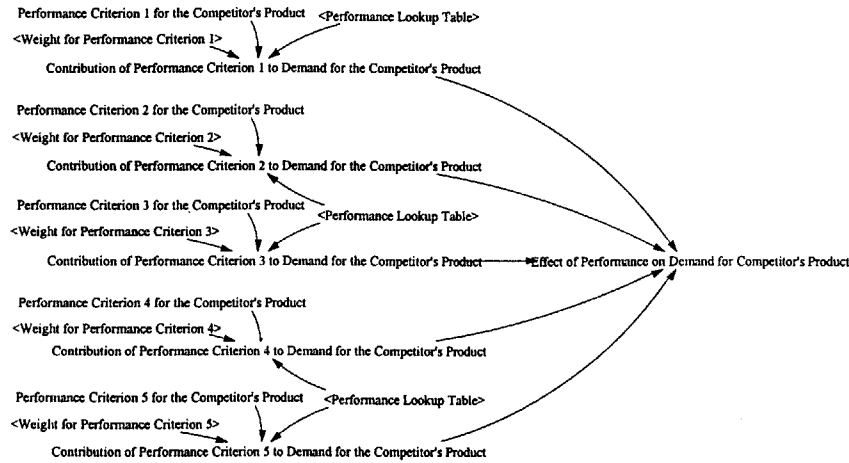


Figure 3 - 14. Effect of Performance on Demand for Competitor's Product

3.4 Relative Performance

Relative performance ratings for the new and the competing products are measured as shown in Figures 3-15 and 3-16. These ratings are used to calculate the new products Differential Performance rating Against Competitor's Product, which is used to determine the Effect of Relative Performance on the Indicated Unit Price. See Appendix B for the actual formulation.

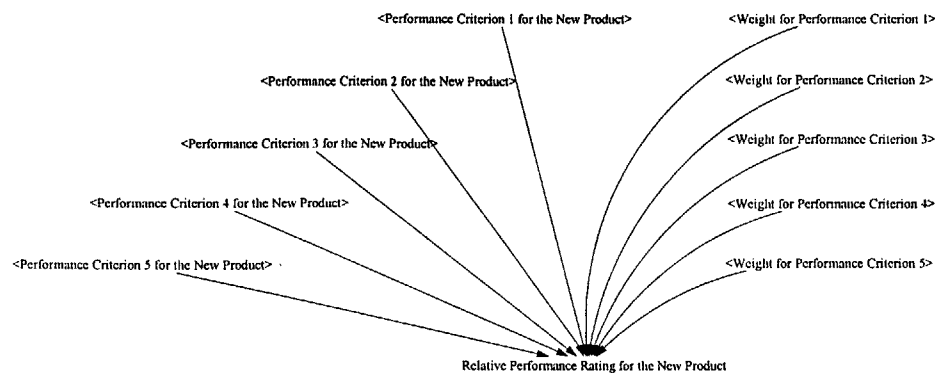


Figure 3 - 15. Relative Performance Rating for the New Product

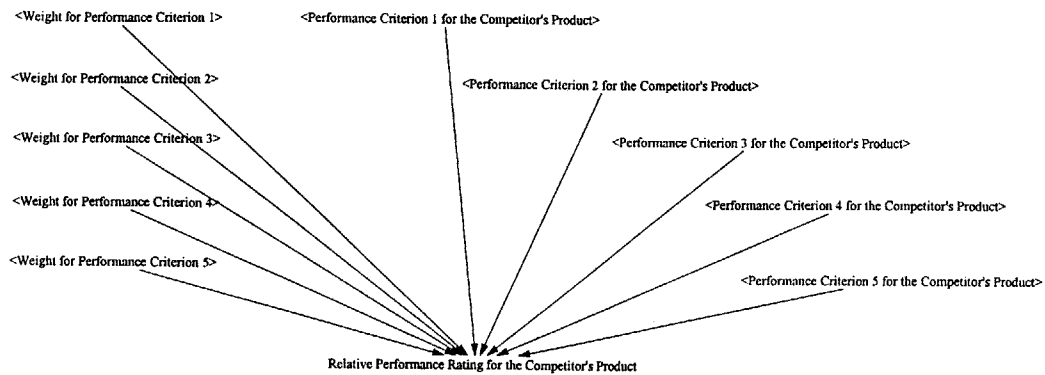


Figure 3 - 16. Relative Performance Rating for the Competitor's Product

3.5 Brand

Figure 3-17 shows that the effect of brand on demand of each company's products is based on percentage of the market that favor the brand of each company. A lookup table allows the user to determine how demand is affected as a function such percentages.

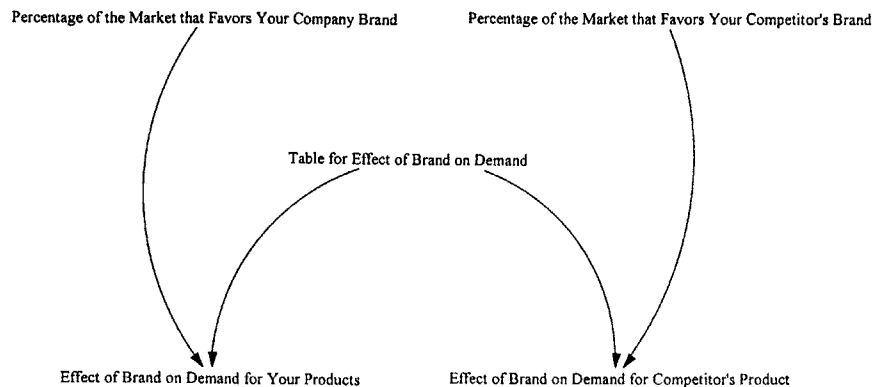


Figure 3 - 17. Brand

3.6 Risk

Risk is intended to quantify the company's risk in commercializing a new product based on a new technology. This risk does not apply to the existing and competing products. This quantification is based on five simple risk criteria, each of which is weighted based on its relative importance. The user is invited

to define his or her own risk criteria by assigning new names to them. However, as shown in Figure 3-18, the five risk criteria that are specified here deal with:

- Risk related to product delivery schedule,
- Risk related to reliability and feasibility of the new technology, and
- Risks related to the newness of the technology and its application.

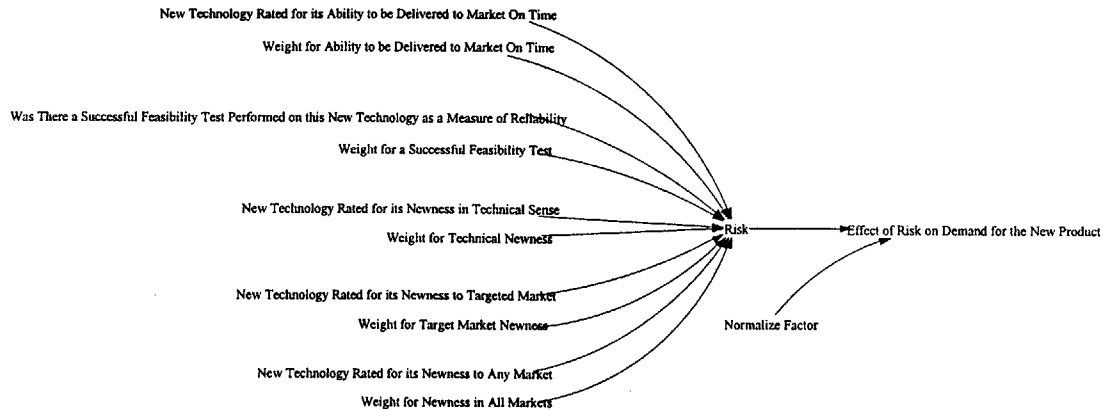


Figure 3 - 18. Risk

3.7 Switching Cost

Switching cost is a subtle but a very important consideration for a new product based on a new technology. The three types of switching costs are formulated as follows:

3.7.1 Direct Costs

As shown in Figure 3-19, the Contribution of Direct Costs to Switching Cost is based on the Minimum Directs Costs as Percent of Unit Price. The Minimum Directs Costs as Percent of Unit Price accounts for the minimum costs incurred by the customer for switching from an existing product (based on an existing technology) to a new product (based on a new technology). This cost is measured as a percentage of the unit price and includes all direct costs such as installation, training and removal of the old product. A lookup table is used to determine the contribution of the direct costs based on the indicated percentage.

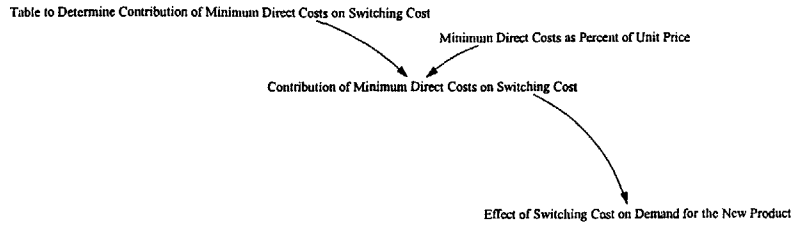


Figure 3 - 19. Contribution of Direct Costs to Switching Cost

3.7.2 Indirect Costs

As shown in Figure 3-20, the mechanism to determine the Contribution of Indirect Costs on Switching Cost is similar to that of direct costs. As an input to the model, the Indirect Costs and Risk of Switching is a rating from 0 to 10, where 10 indicates very high indirect cost and risk. Indirect cost and risks are associated with loss of productivity during switching. The exact scope of such losses are difficult to estimate because the newness of the product.

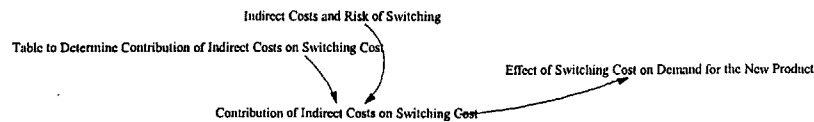


Figure 3 - 20. Contribution of Indirect Costs to Switching Cost

3.7.3 Opportunity Cost

As shown in Figure 3-21, the mechanism to determine the Contribution of Opportunity Cost on Switching Cost is similar to that of the other two cost factors. However, unlike the other two cost factors, opportunity cost works in favor of switching. The Opportunity Cost of Not Switching is rating of 0 to 10, where 10 indicates a high opportunity cost if the a customer does not switch to the new product.

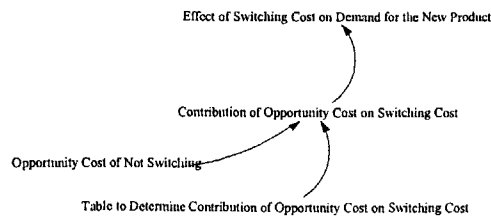


Figure 3 - 21. Contribution of Opportunity Cost to Switching Cost

3.8 Adjustments on Effects

In this section, the effects of price, performance, brand, risk and switching cost on demand of different products are adjusted for two factors, both of which are functions of market sensitivities.

1. Delay – Delay is a delay in time before an effect materializes. For example, effect of a price change is not immediate. It may take several months before a price change affects demand.
2. Weight – Effects are weighted for relative importance. For example, in a price-sensitive market, effect of price on demand is weighted more than other effects.

The only exception is that there is no delay used for the Effect of Risk on Demand for the New product.

Two lookup tables are used for adjustments of these effects. One table is for effects that are lower than 1 and the other for effects higher than 1. If during the simulation, an effect makes a transition from across 1, there may be a discontinuity in adjustments. Lookup table values must be selected carefully to avoid such discontinuity. Figure 3-22 shows a graphical example of an adjustment.

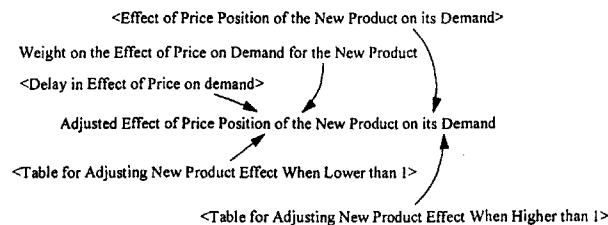


Figure 3 - 22. Adjustments of Effects

3.9 Installed Base

The overall installed base for all products is a function of the installed bases for each product as shown in Figure 3-23. The company's install base is tracked separately to calculate the company's Market Share. The impact of the New Product on Market Share is one measure of success for the new technology.

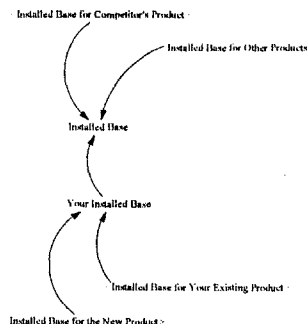


Figure 3 - 23. Installed Base

3.9.1 Market Share

The market share for the company with the new and existing product is measured as shown in Figure 3-24. In this case, Market Share is a simple percentage of the total Installed Base based on Your Installed Base.

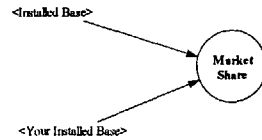


Figure 3 - 24. Market Share

3.10 Net Present Value

The NPV for the New Product is a measure of success for the new product. As shown in Figure 3-25, NPV is calculated based on the present value of accumulated profit for all units sold less present value of all capital investments.

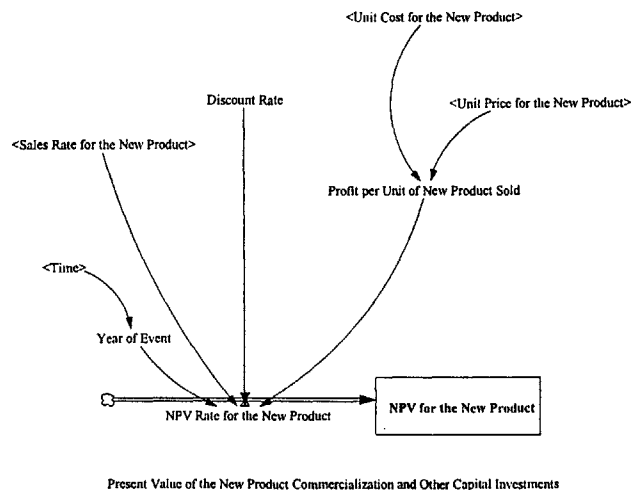


Figure 3 - 25. Net Present Value

3.10.1 NPV from Additional Products and Services

As shown in Figure 3-26, the net present value from the sales of additional products and services is calculated. However, this measure is used only if such sales are a direct result of selling the new product. In fact, this value is based on the number of new products sold.

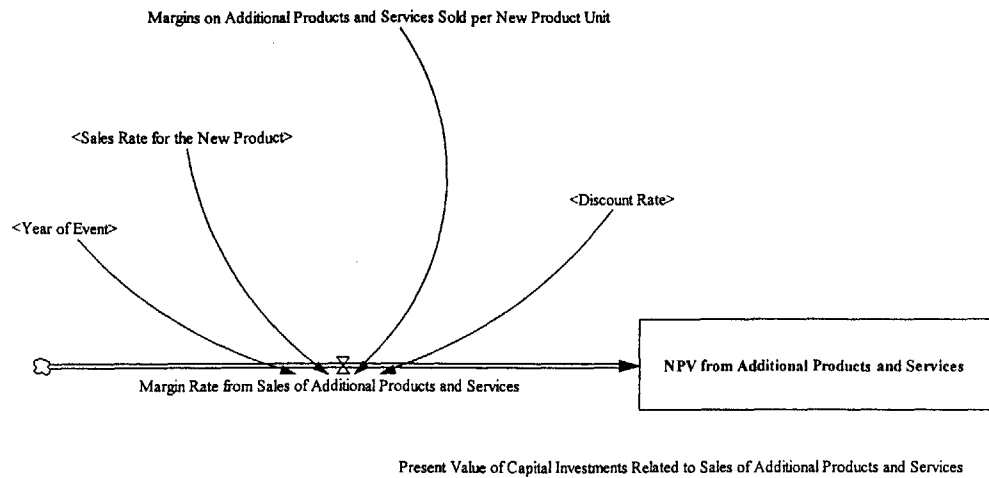


Figure 3 - 26. NPV from Additional Products and Services

3.11 First View for Inputting Data

For ease of entry, this view contains shadow variables for a subset of inputs to model. The following groups of inputs are handled in this view:

1. Simulation Time
2. Market and Adjustment Effects
3. Availability
4. Cost

3.12 Second View for Inputting Data

The following groups of inputs are handled in this view:

5. Pricing
6. Performance
7. Brand
8. Risk

3.13 Third View for Inputting Data

The following groups of inputs are handled in this view:

- 9. Switching Cost
- 10. Net Present Value.

4 USAGE RECOMMENDATIONS

This chapter contains a number of recommendations for use of the model:

1. By default, the model is designed for simulation in units of 0.015625 years; i.e. Time Step = 0.015625. However, the user is free to change this setting to any desired time step as long as the selected time step is less than one-fourth of the smallest delay in the model. Also, the default duration of the simulation is by 20 years; i.e. Final Time = 20. This setting should almost certainly be changed based on simulation requirements.
2. The model should be used when:
 - A new technology is available,
 - A concept for a new product is available,
 - A business case for the new product is available
3. The input form attached in Appendix C is helpful in capturing the inputs for the model. It is best to collect the inputs from a team composed of both marketing and technical people.
4. The lookup tables are critical for the simulation. Default tables are documented in the model documentation in Appendix B. However, the tables have to be reviewed by the team to ensure their validity for the type of product and market being used.
5. Factors related to market sensitivity should be selected as appropriate for the market being considered.
6. Some of the formulations may be changed as suited for the type of product and market (see test case for an example).
7. Before using the model, it is best to calibrate and validate it using existing products with the same attributes as the new product. Adjustments made during calibration may affect lookup tables, market factors or some formulations. Then, the calibrated model may be used for final screening.
8. In general, the results in the early parts of the simulation tend to be more accurate. It is difficult to predict future behaviors accurately.

5 TEST CASE

A test case is included in this chapter to demonstrate the use of the model. However, this test case is not intended to be an absolute guide for use of the model. Furthermore, the test case is based on a completely new technology and its application in the Aircraft Industry. Specific information about the nature of this new technology, products and companies are withheld, and other information about actual cost, price and investment are changed to protect the companies involved.

References are made to two companies: Company A and Company B. Company A is doing the evaluation of the new technology, while Company B owns the new technology and is using it to develop a new aircraft. The new technology radically changes the design and attributes of the new aircraft, and by evaluating it using this model, Company A wants to know whether they should also pursue this new technology.

The strategy used in the evaluation is as follows:

1. Calibrate the model using existing products, and
2. Use the calibrated model to evaluate the new technology from Company B's point of view. The model was used to evaluate the new technology and the new product concept of Company B. Doing so, Company A planned to simulate market dynamics if Company B continued to pursue its new technology while Company A did nothing.

5.1 Calibration

The purpose of this step is to make the model conform to the nuances of the particular Aircraft Industry being considered. The following actions were taken:

1. Inputs were collected that related to existing products from Company A and Company B. Obviously, the existing products use existing technologies that are similar to one another. The new technology was not considered for calibration. The collected information was sorted as follows:
 - The New Product in the model was linked to Company A's existing product. Therefore, price and performance information for the new product came from that of Company A's existing product.
 - The Competitor's Product in the model was linked to Company B's existing product. Therefore, price and performance information for the competing product came from that of Company B's existing product.

- The Existing Product in the model was not used.
2. Brand information for both Company A and Company B was used in the model as it corresponded to the new and competing products.
 3. The effects of Risk and Switching Cost were neutralized. For the purpose of calibration using existing products, this action made sense.
 4. Availability values (production rates) were set to values higher than expected sales because companies did not operate at capacity. It must be noted that a large value for the Availability of the New Product adversely affected the Indicated Unit Price for the New Product. The reason was the feedback loop that is used to force the price lower in case of surplus. Therefore, since the expected sales rate was approximately 25 units per year, availability was set to 30 units per year. The result was a reasonable output for the Effect of Shortage or Surplus on the Indicated Unit Price as shown in Figure 5-1.

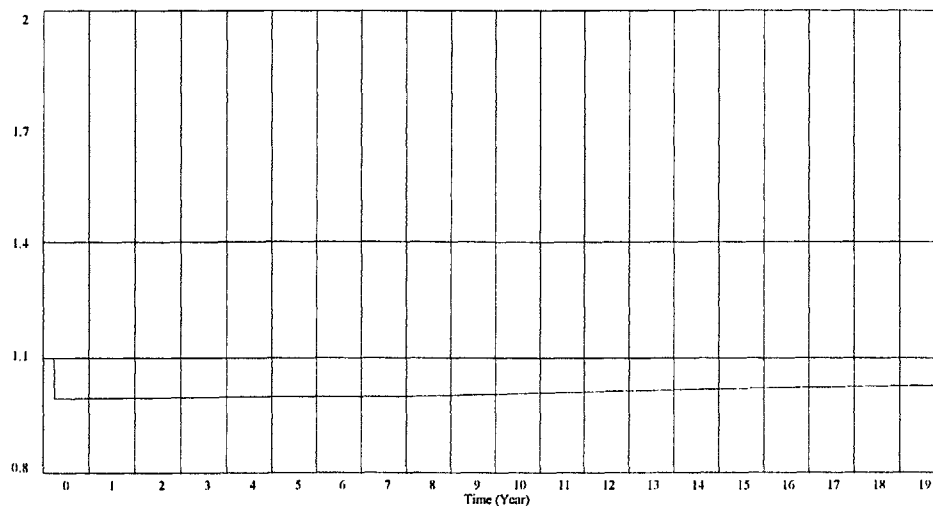


Figure 5-1. Graph for Effect of Shortage or Surplus on the Indicated Unit Price

5. The markets sensitivity to price, performance and brand were adjusted to 40%, 40% and 20%, respectively. Other market data and model conditions were adjusted to reproduce known market conditions as the result of model simulation. This was an iterative step.

The most notable adjustment made to the model was to change the formulation of the Desired Unit Price. Originally, the Desired Unit Price was calculated as a function of the Desired Unit Price Based on Margin and the Minimum Unit Price as well as the Desired Unit Price Based on Competitive Positioning. The link to the Desired Unit Price Based on Margin caused the Desired Unit Price to reduce as the Unit Cost for the New Product reduced. However, the more realistic approach for this

industry turned out to be to maintain a price position relative to the competition. Therefore, the formulation for the Desired Unit Price was changed to make it only a function of the Desired Unit Price Based on Competitive Positioning. Figure 5-2 shows the Indicated Unit Price for the New Product, which stays around \$7 million as expected.

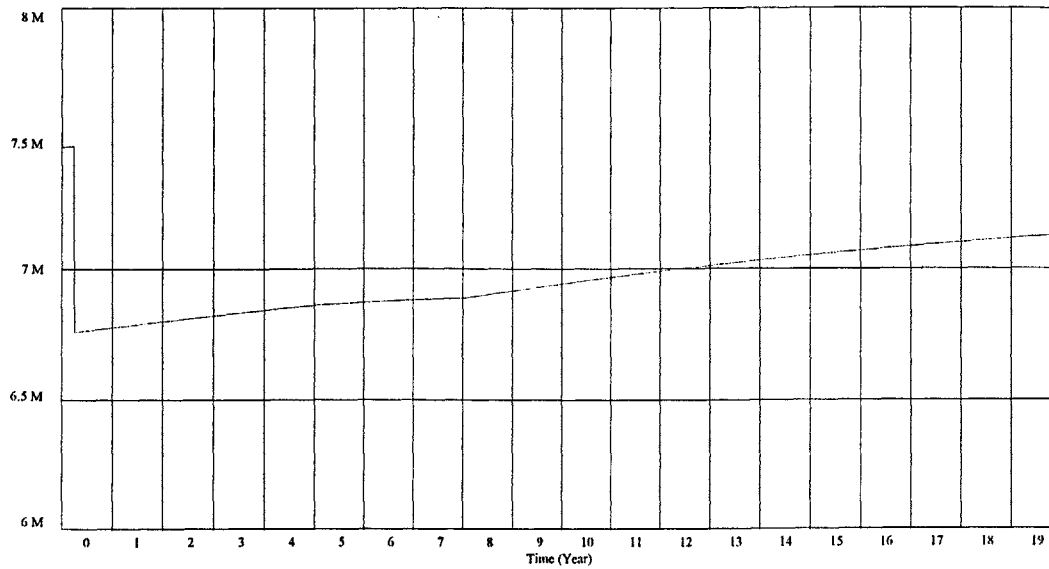


Figure 5-2. Graph for Indicated Unit Price for the New Product

6. According to the industry standards, the Unit Cost for the New Product (for Company A) followed an 85% learning curve¹⁶. This unit cost started at \$5 million as shown in Figure 5-3.

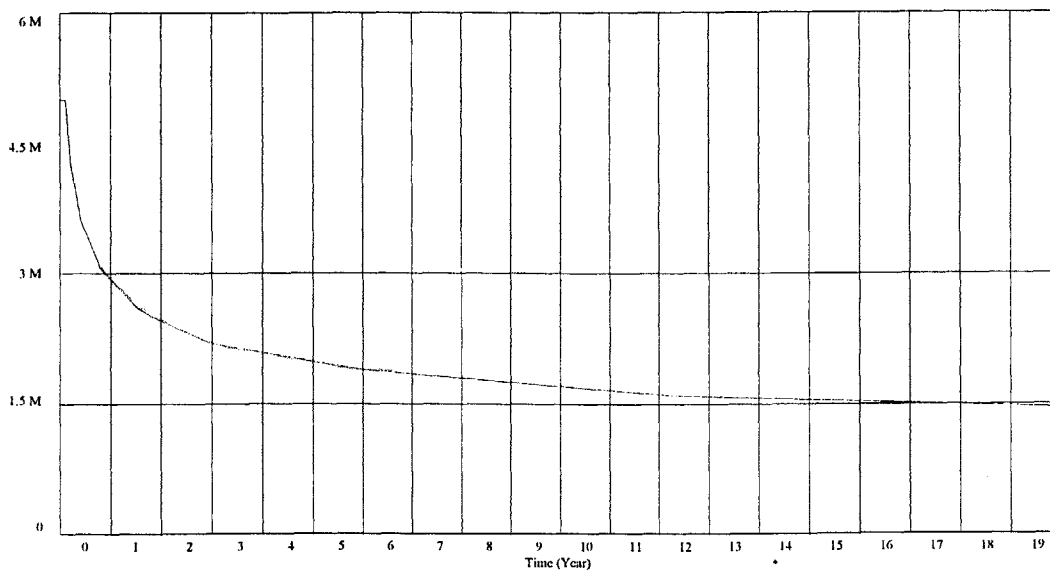


Figure 5-3. Graph for Unit Cost for the New Product

¹⁶ Unit cost was reduced by 15% every time that the production doubled.

The main goal of this exercise was to replicate the performance of Company A's product against other products in the market. This goal was to be achieved given the pricing and sales pattern for all products as well as the relative performance data available. According to the actual data, over the last 20 years, the installed bases for Company A and Company B reached 400 units each while their unit prices approached \$7 million and \$6.5 million, respectively. As shown in Figure 5-4, this goal was achieved. Note that the difference between the total installed base and the sum of Company A and Company B installed bases is the number of installed bases for Other Products, which is not shown.

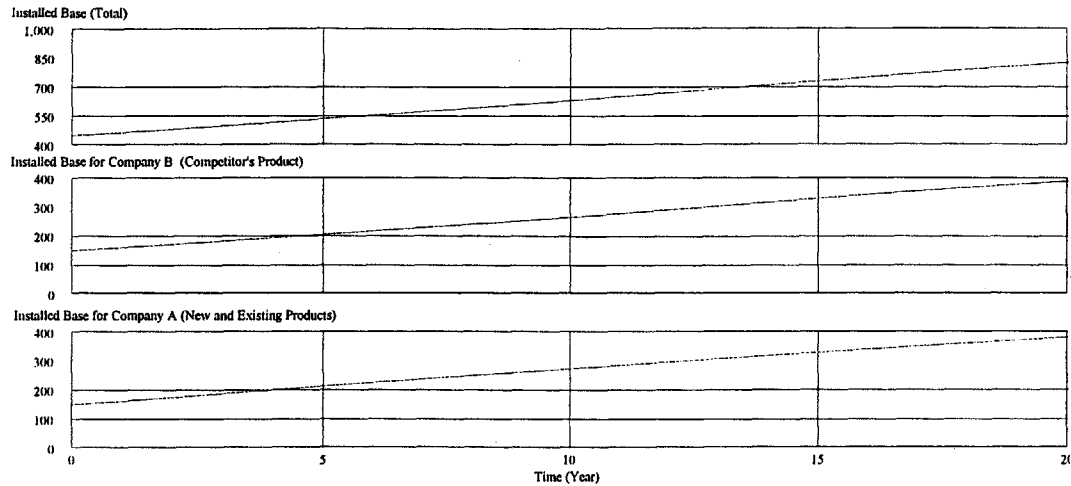


Figure 5-4. Graph for Installed Bases

5.2 Evaluation

For the actual evaluation, the products were considered as follows:

- The New Product in the model was linked to Company B's new product concept that is primarily based on the new technology. Therefore, price and performance information for the new product was estimated based on Company B's new product. Please note that Company A intended to evaluate the new technology from Company B's point of view; thus, Company B's new technology and product were the main focus.
- The Competitor's Product in the model was linked to Company A's existing product. Therefore, price and performance information for the competing product came from that of Company A's existing product. This was based on the premise that Company A was not going to pursue the new technology for simulation purposes.

- The Existing Product in the model was linked to Company B's existing product. Therefore, price and performance information for the existing product of the model came from that of Company B's existing product.

Furthermore, the following changes were made to the model:

- Since a new technology is being evaluated and there are elements of risk involved, Risk and Switching Cost data were entered into the model. Accordingly, the weight factors for the effects of price, performance, brand, risk and switching cost were adjusted. The weight factors for risk and switching cost were tailored to linearly reduce over time because the longer the new product remains in the market the lower will be the effects of risk and switching cost. Of course, this implies that the weight factors for price, performance and brand were adjusted to linearly increase over time. This means that as the importance of risk and switching cost lessens, the effects of price, performance and brand become more pronounced.
- The Table for Incremental Market Growth was adjusted for 2% annual growth, which is mainly due to the new applications and uses that were made possible by the new technology.

A number of output graphs are attached in Appendix D. These graphs represent some of the key outputs of the model. Figures D-4 and D-10 suggest that the New Product can break even in the first year after selling twelve (12) units. The NPV for the New Product is \$580 million calculated at the end of 20 years.

These upbeat figures are mainly the result of three assumptions:

1. It is assumed that the market will grow at a rate of 2% per year. In addition, it is assumed that the new applications and uses made possible by the new technology result in another 2% annual growth (see Figures D-5 and D-6 for potential demand). Note that the new technology is expected to introduce a radical change in the industry. Without further specificity, these appear to be reasonable assumptions.
2. The model assumes that the competition will not introduce a new product based on the new technology. In reality, the competition is Company A who is doing the evaluation. After observing such high returns, it is doubtful that Company A will forego this opportunity. Company A can now modify the model and evaluate the market dynamics in a more competitive setting. This new model has not been included here.
3. The model includes many assumptions in how the market reacts to the new technology or how the new product is positioned against competing products in terms of performance and price. An effort was made to be as objective as possible about these assumptions. However, the model provides the user with the opportunity to analyze the sensitivity of each of these assumptions independently. This is a very powerful capability.

Figure D-3 shows a very small growth (more than 1 percent) in the market share due to the new technology. This suggests that the high return on investment is mainly due to expected profits as opposed to an increase in installed base. This is confirmed by studying Figures D-8 and D-9. The price is kept at a constant level of almost \$10 million, while unit cost is reduced to nearly \$3.5 million. In absence of any competition, this might be a reasonable outcome. However, if competition enters the market and production decreases, unit cost will not drop as sharply as Figure D-9 suggests. The reason for this logic is that unit cost is a function of an 85% learning curve, and if the production becomes limited, the effects of the learning curve will be limited.

Another consideration involves the sales of the Existing Product. According to Figure D-11, the Installed Base for Your Existing Product shrinks from 400 to 274 units. This is an indication that the new product will cannibalize the existing product, which might be a more serious issue if competition is introduced in the market.

6 CONCLUSION

A system dynamics model was presented for use as a tool for evaluating a new technology and analyzing its readiness for the market. This model provides a management team with a number of distinct advantages. It devises a relatively realistic setting under which options and assumptions regarding a new product concept and its commercialization can be examined alike. It is a tool that if used correctly, enhances objectivity. Its dynamic nature and multi-dimensional capabilities allows one to consider technical and business factors as parts of one aggregate system. Yet, one can iterate through many “what if” scenarios to isolate the effect of any one factor that is considered in the model.

Notwithstanding the many advantages that this model presents, in a product planning and development process, this model does not stand alone. This model is but one tool that needs to be used with other tools and processes. Furthermore, the model relies heavily on the integrity of its inputs. As with most other tools, wrong inputs lead to wrong conclusions. Therefore, it is suggested that one should take advantage of the strengths of the model. It should be used in an iterative fashion to learn more about ones options and assumptions. It can be a critical tool for analyzing the market and competitive reactions to various scenarios defined by relative performance characteristics of a new product, its pricing options, its brand, its cost, company’s risk, consumer switching costs, market size, new opportunities, market sensitivities, and more. The model is not intended to be an absolute predictor of success or failure for the new technology – it is intended to be a learning tool.

The model presupposes that any effort in evaluating a new technology is strongly linked with the evaluation of the new products that it makes possible. Thus, the model seems to put a lot of weight behind the performance of the new product. It was argued that this is a perfectly legitimate approach. A new technology can be regarded as a differentiating factor for better products. But, ultimately, it is the product that corroborates the worth of a new technology and ascertains its success or failure. However, in all fairness, for a new product to cast back the value of its enabling technology, the characteristics of the new technology must be evident. A concept for the new product should be carefully selected to realize the value of the new technology.

Perhaps of the most valuable contributions of this work has been to consider switching cost as a factor for evaluating a new technology. Switching cost was defined as cost associated with a consumer switching from an existing technology to a new one. Such costs were classified as direct and indirect costs of switching as well as opportunity cost in not switching. The direct switching cost – a negative cost - is the most obvious of all. In fact market sensitivity to price is largely related to direct costs. Next, opportunity cost – a positive cost - becomes prominent and manifests itself as a positive driving force for consumers to switch. Prestige of owning a new product that uses a new technology (e.g. wireless telephone) is an

example of an opportunity cost. But the most understated switching cost is the indirect cost – another negative cost. Usually, in all the excitement and hype that surrounds a new technology, it is easy to ignore what indirect costs the new technology will carry with it. For example, a new product may require training, which may be dismissed as a simple task when the new technology is being discussed. However, during purchasing stages, training and its ramifications may block the purchase all together. As subtle as the indirect switching costs might appear, they play a very critical role in moving a new product from where it is accepted by early adapters to where it is embraced by the early majority in the market.

Another important consideration was cannibalization. The fear of cannibalizing the existing products by introducing new ones can serve as a powerful deterrent in introducing new products to the market. However, in a competitive environment, if a company chooses not to cannibalize its own existing products, its competitors will do that. The model provides the user to consider cannibalization alongside the competitor's strategies.

A few lessons were learned as the result of the test case studied in chapter 5. As it was demonstrated in the test case, the model may be used as a competitive tool for evaluation of the competitors' strategies. In the test case, one company evaluated a new technology/product that was being developed by its main competitor. As such, the application of the model extended from a tool for internal assessment to one that may be used for external assessment. Thus, the model may be used to analyze the competitor's options and approaches.

Another lesson learned by the test case was that market sensitivities play a critical role in the overall assessment of a new technology. This was illustrated when the formulation for pricing was changed to match what is practiced in the particular aircraft industry that was considered. Without this change, calibration would have been impossible. Other considerations related to market sensitivities included attention to the markets sensitivity toward price, performance and brand.

Another point demonstrated by the test case was that the behavior of the model is sensitive to the market growth. Indeed, market growth defines the extent of the opportunity that a company faces when considering a new technology or a new product. The more the market grows the more will the opportunity for success be. But also, the model considers that a new technology can help grow the market by creating new applications and uses.

Finally, the model presents a number of opportunities for further work. First, the structure of the model may be restrictive in some cases. It considers four (4) products: the company's new product, the company's existing product, the competitor's product, and other products. In certain cases, these four products may not be the right mix for consideration. This structure may be expanded to one that is more conducive to more situations.

Second, the dynamic linkage for performance, brand, risk and switching cost may be enhanced for a more powerful model. At it stands for example, although brand affects the performance of the new product, it stays static and leaves a void for further feedback. The model requires predictive mechanisms to regulate the market's perception of brand in light of the company's general performance and pricing.

Third, other factors may be dynamically linked into the model. For example, competency, advertising, and budgeting may be added to it for a more powerful model. Specifically, advertising can play a critical role in boosting sales. However, advertising may be limited due to restricted budgets, which may be due to poor past performance of the company, thus creating a powerful dynamics to consider.

Fourth, as previously mentioned in Section 2.4, more can be done in the area of success criteria. Specifically, the option value of the new technology / product may be included in the calculation of the NPV. The new technology / product holds an option value because prior to commercialization, the option provides the company with a valuable possibility of waiting for new information about the market conditions. Instead of looking for a positive NPV, it may be more prudent to look for a NPV that is greater than the option value.

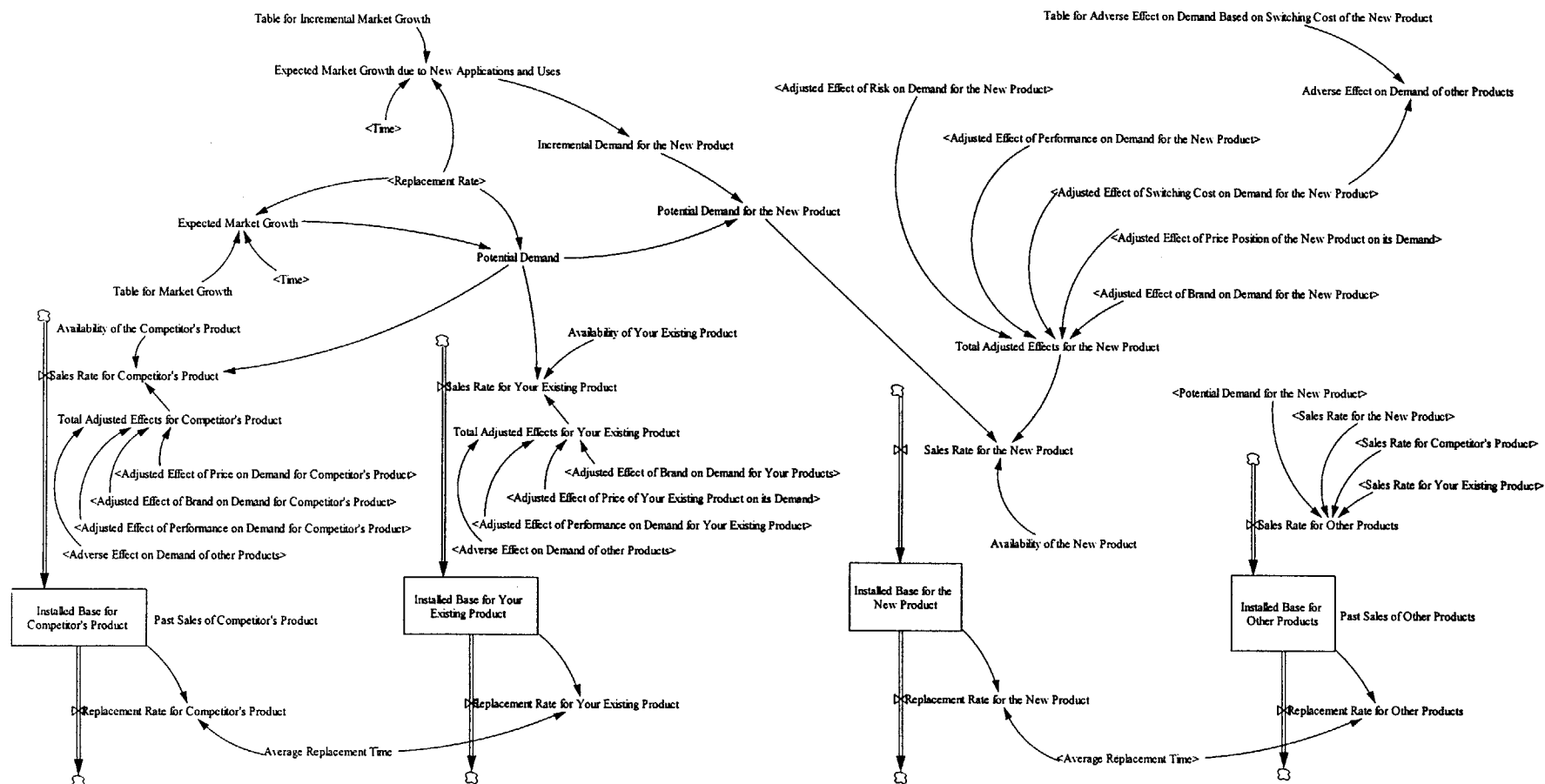
As a new research topic, the effectiveness of net present valuation may be compare to that of "strategic valuation". This would be a comparison between the more common approach of using NPV as a measure of success against using the option approach and/or organizational capabilities.

APPENDIX A -- MODEL DIAGRAMS

The model contains 13 views listed as follows:

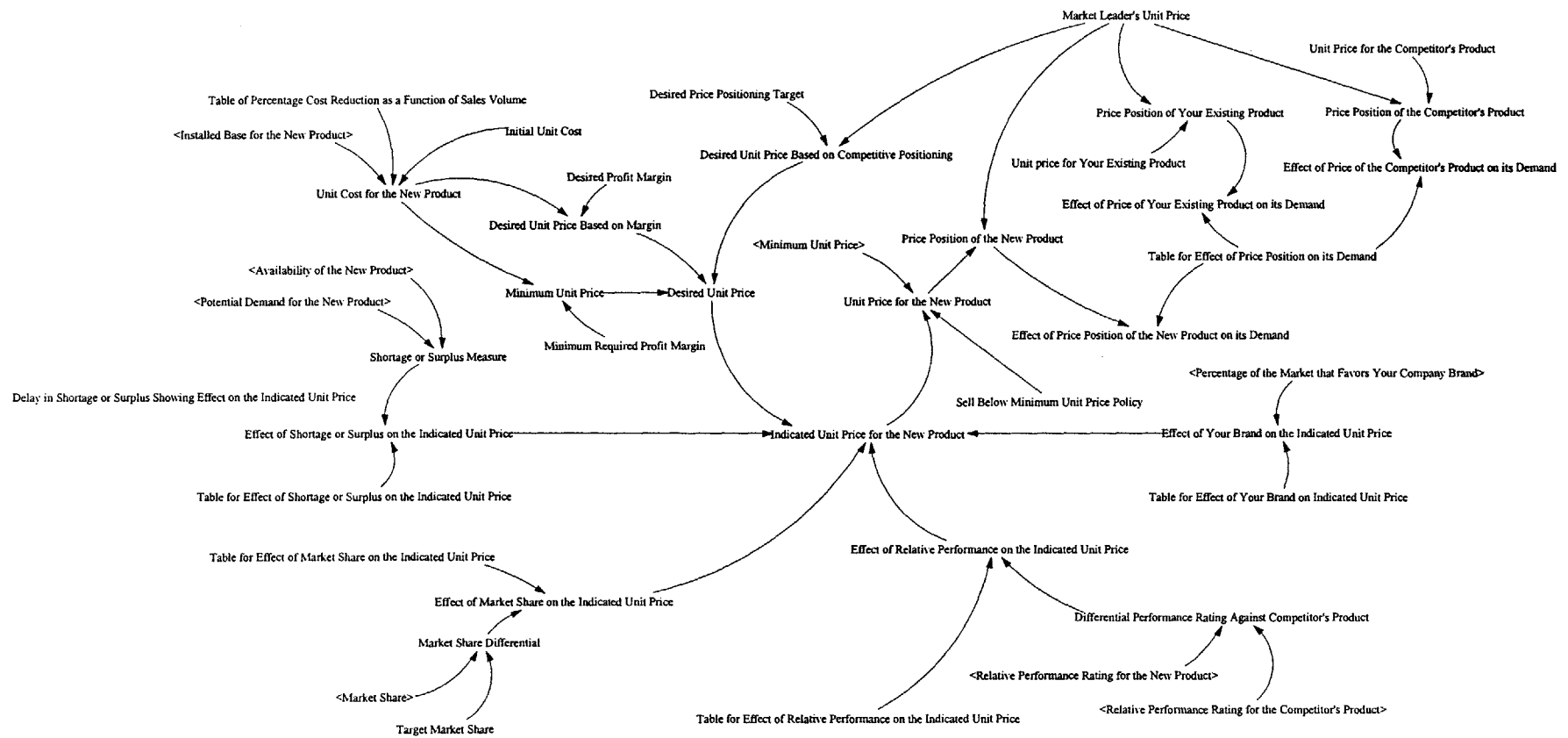
1. Main View of the Model
2. View on Price
3. View on Performance
4. View on Relative Performance
5. View on Brand
6. View on Risk
7. View on Switching Cost
8. View on Adjustment of Effects
9. View on Installed Base
10. View on Net Present Value
11. First View for Inputting Data
12. Second View for Inputting Data
13. Third View for Inputting Data

Graphical representation of each view is contained in the following pages.



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Figure A - 1. Main View of the Model



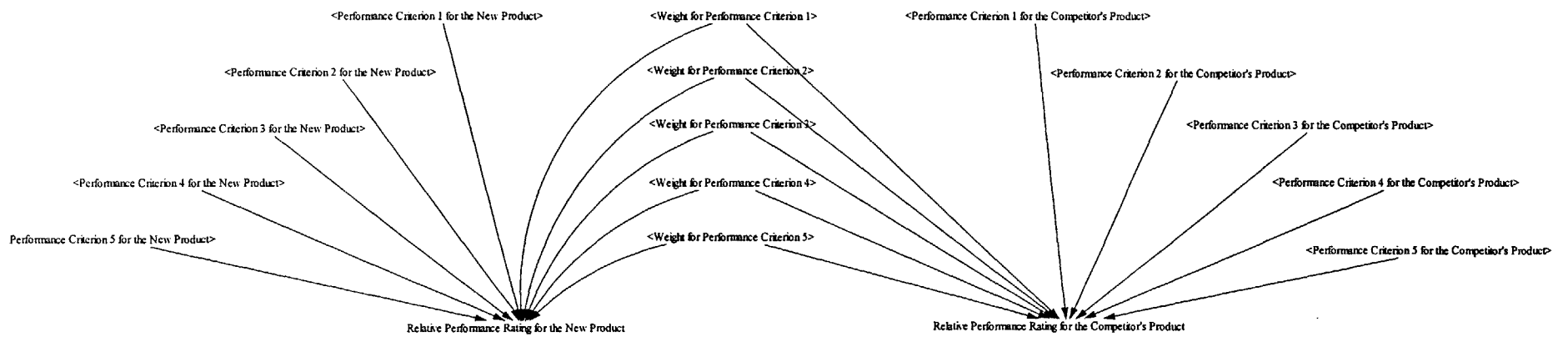
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Figure A - 2. View on Price



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Figure A - 3. View on Performance

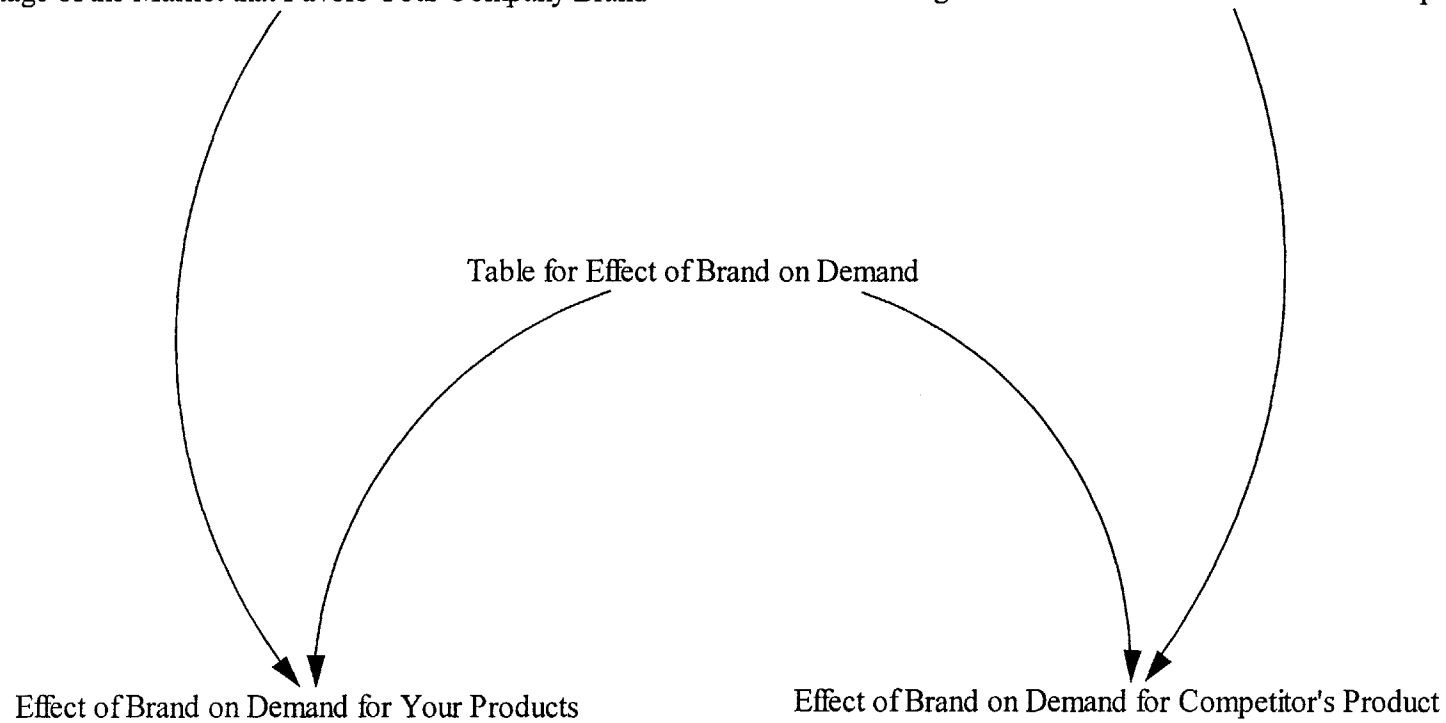


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Figure A - 4. View on Relative Performance

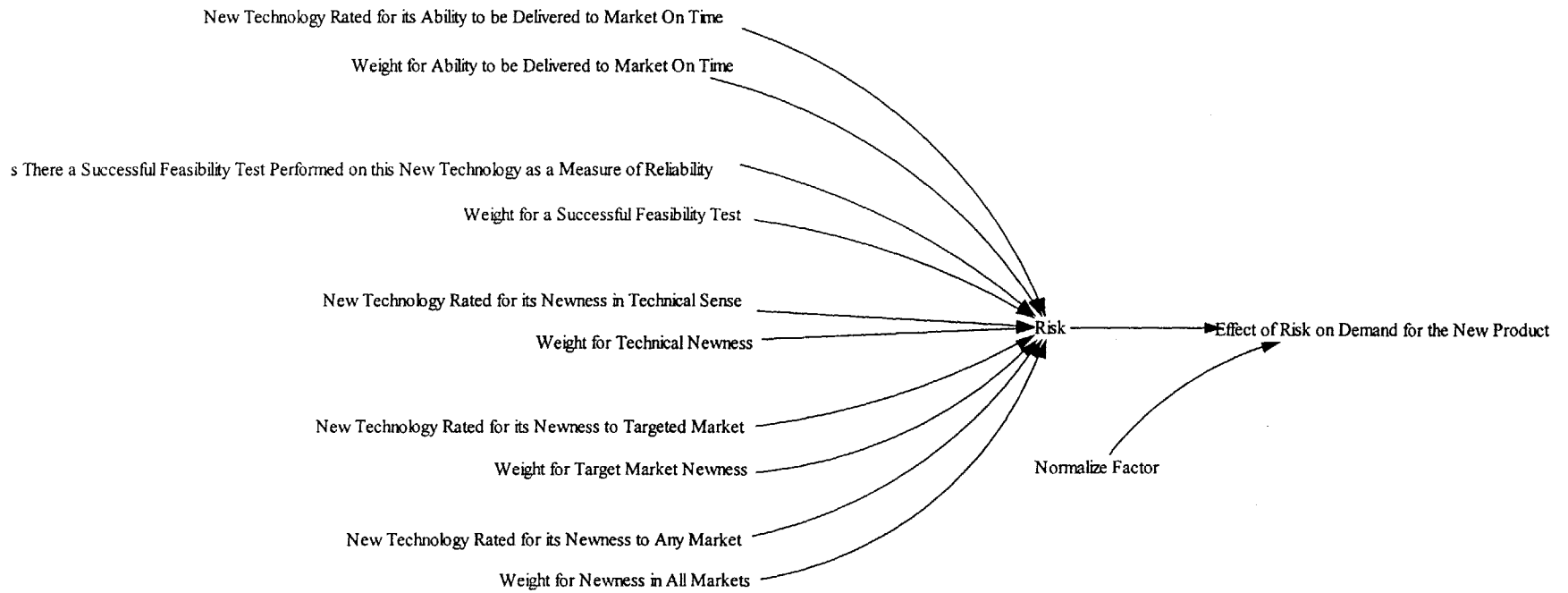
ercentage of the Market that Favors Your Company Brand

Percentage of the Market that Favors Your Competitor's Brand



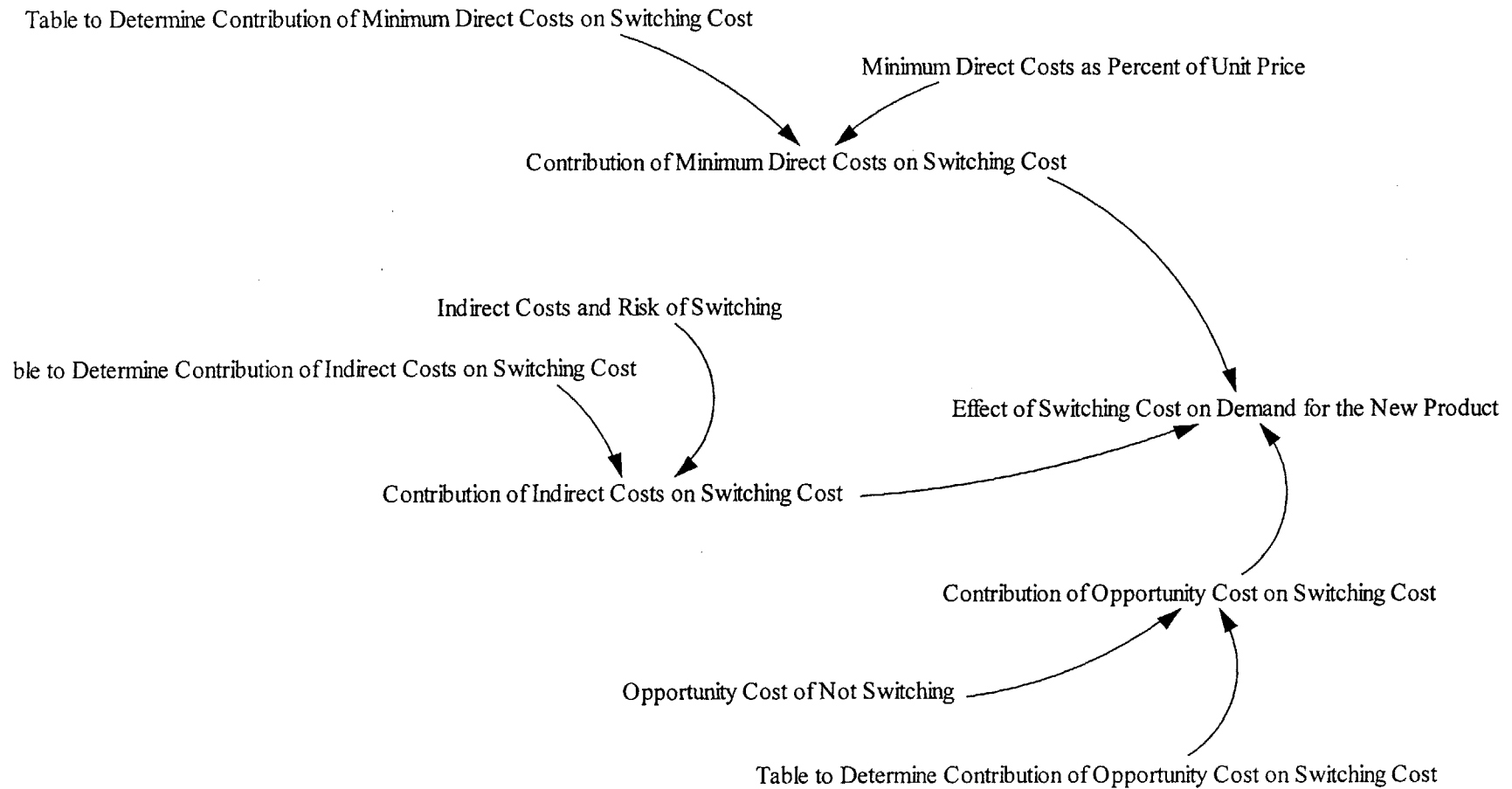
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Figure A - 5. View on Brand



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Figure A - 6. View on Risk



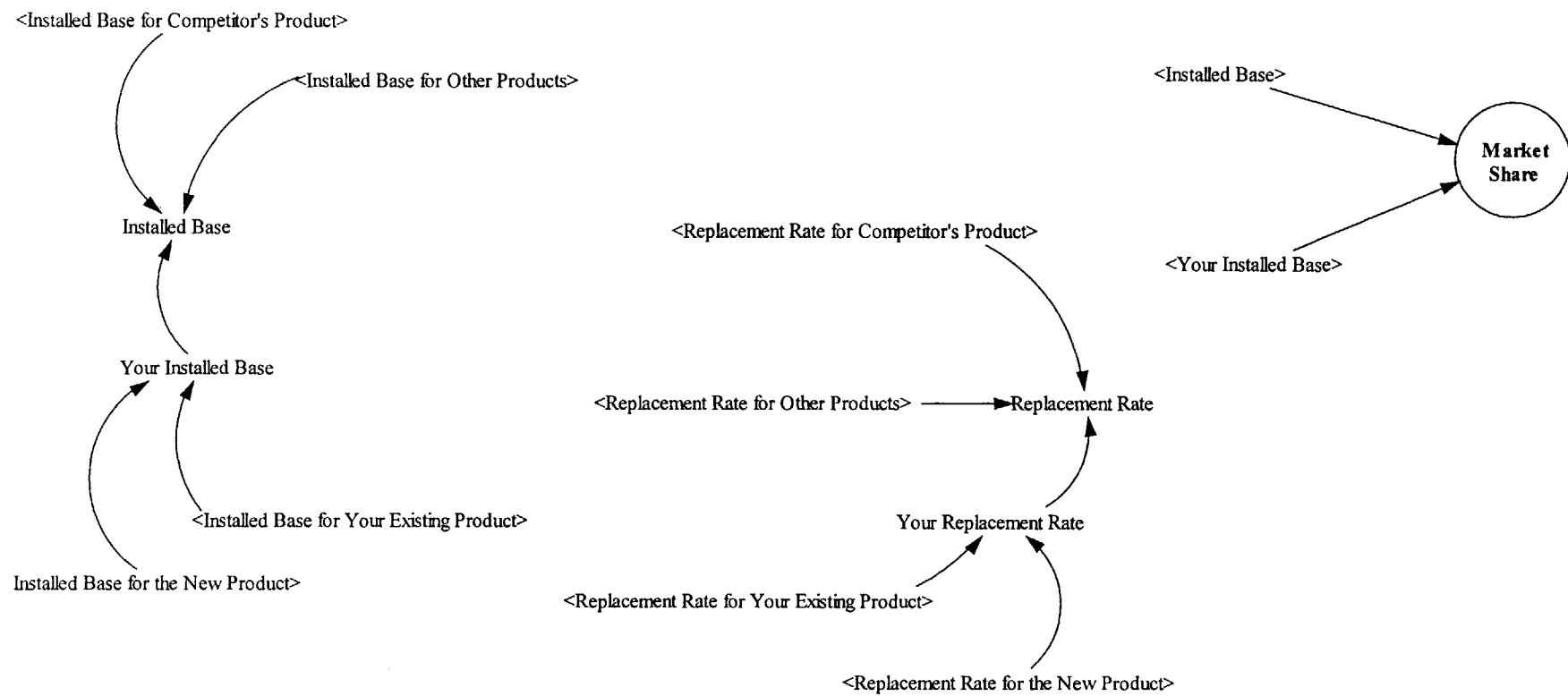
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Figure A - 7. View on Switching Cost



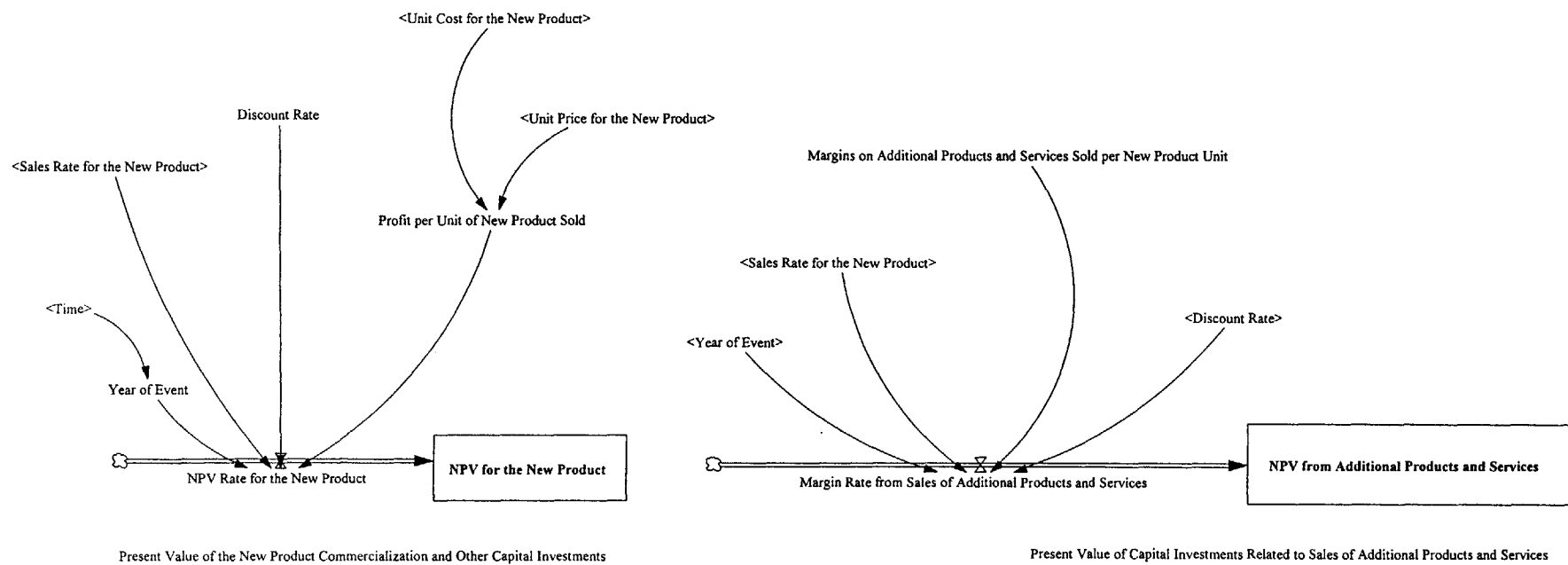
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Figure A - 8. View on Adjustment of Effects



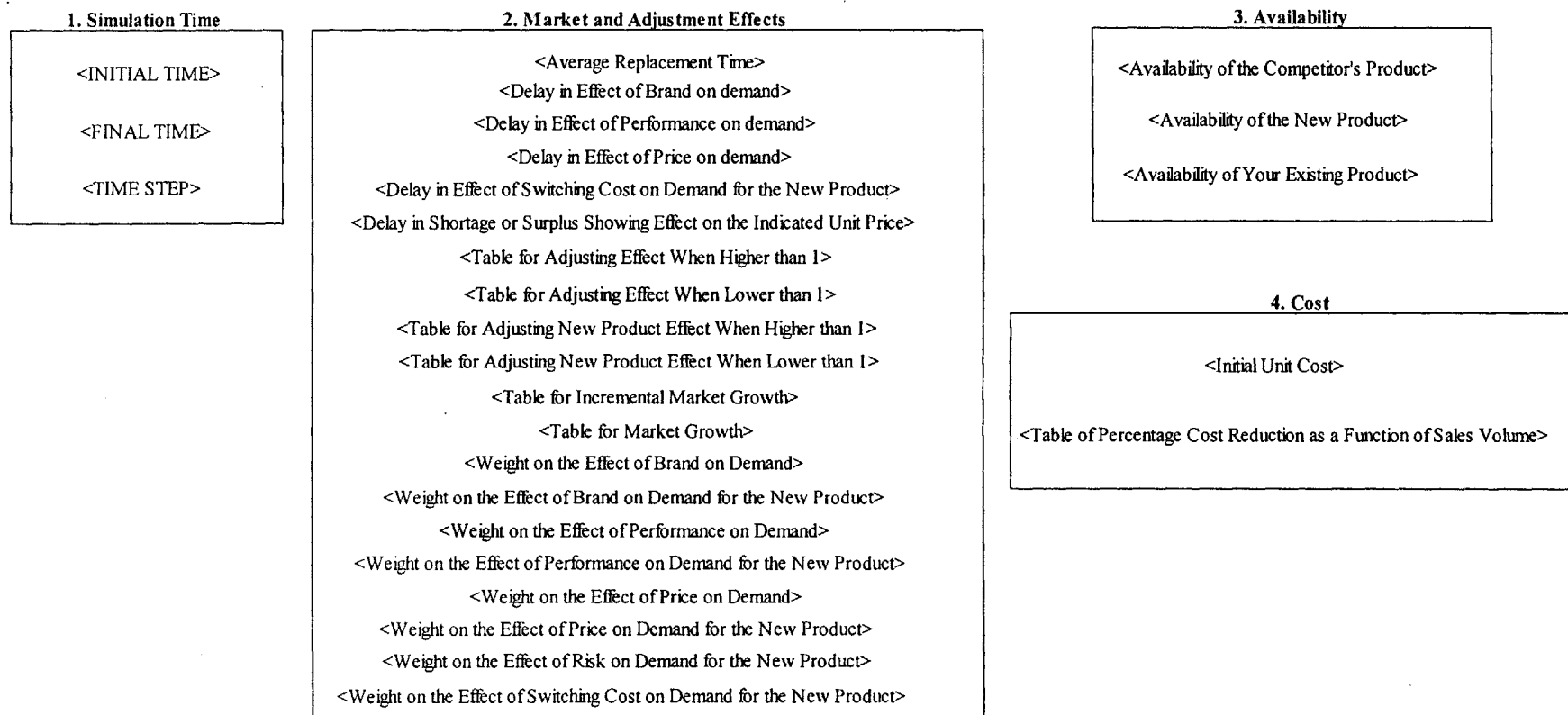
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Figure A - 9. View on Installed Base



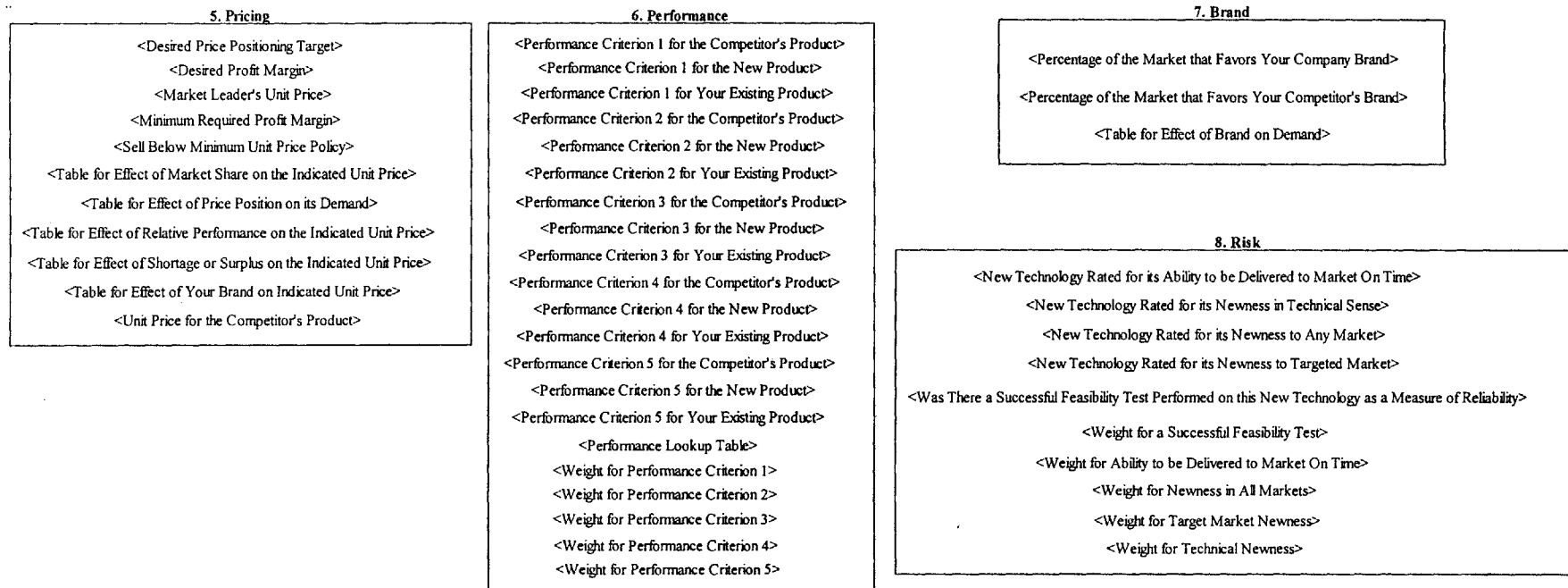
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Figure A - 10. View on Net Present Value



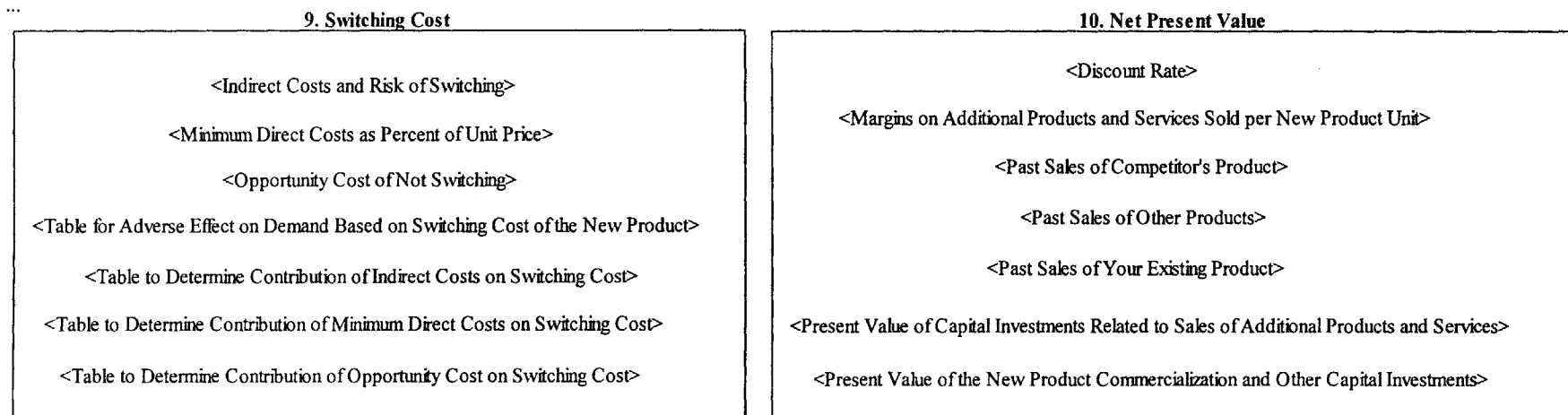
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Figure A - 11. First View for Inputting Data



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Figure A - 12. Second View for Inputting Data



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Figure A - 13. Third View for Inputting Data

APPENDIX B -- MODEL DOCUMENTATION

Variables used in the model are listed in alphabetical order. The unit of measure and a brief description (if any) is included for each variable.

Adjusted Effect of Brand on Demand for Competitor's Product =

IF THEN ELSE (Effect of Brand on Demand for Competitor's Product < 1, DELAY3 (Effect of Brand on Demand for Competitor's Product * Table for Adjusting Effect When Lower than 1 (Weight on the Effect of Brand on Demand), Delay in Effect of Brand on demand), IF THEN ELSE (Effect of Brand on Demand for Competitor's Product > 1, DELAY3 (Effect of Brand on Demand for Competitor's Product * Table for Adjusting Effect When Higher than 1 (Weight on the Effect of Brand on Demand), Delay in Effect of Brand on demand), DELAY3 (Effect of Brand on Demand for Competitor's Product, Delay in Effect of Brand on demand)))

Units: Dimensionless

Adjusted Effect of Brand on Demand for the New Product =

IF THEN ELSE (Effect of Brand on Demand for Your Products < 1, DELAY3 (Effect of Brand on Demand for Your Products * Table for Adjusting New Product Effect When Lower than 1 (Weight on the Effect of Brand on Demand for the New Product), Delay in Effect of Brand on demand), IF THEN ELSE (Effect of Brand on Demand for Your Products > 1, DELAY3 (Effect of Brand on Demand for Your Products * Table for Adjusting New Product Effect When Higher than 1 (Weight on the Effect of Brand on Demand for the New Product), Delay in Effect of Brand on demand), DELAY3 (Effect of Brand on Demand for Your Products, Delay in Effect of Brand on demand)))

Units: Dimensionless

Adjusted Effect of Brand on Demand for Your Products =

IF THEN ELSE (Effect of Brand on Demand for Your Products < 1, DELAY3 (Effect of Brand on Demand for Your Products * Table for Adjusting Effect When Lower than 1 (Weight on the Effect of Brand on Demand), Delay in Effect of Brand on demand), IF THEN ELSE (Effect of Brand on Demand for Your Products > 1, DELAY3 (Effect of Brand on Demand for Your Products * Table for Adjusting Effect When Higher than 1 (Weight on the Effect of Brand on Demand), Delay in Effect of Brand on demand) , DELAY3 (Effect of Brand on Demand for Your Products, Delay in Effect of Brand on demand)))

Units: Dimensionless

Adjusted Effect of Performance on Demand for Competitor's Product =

IF THEN ELSE (Effect of Performance on Demand for Competitor's Product < 1, DELAY3 (Effect of Performance on Demand for Competitor's Product * Table for Adjusting Effect When Lower than 1 (Weight on the Effect of Performance on Demand), Delay in Effect of Performance on demand), IF THEN ELSE (Effect of Performance on Demand for Competitor's Product > 1, DELAY3 (Effect of Performance on Demand for Competitor's Product * Table for Adjusting Effect When Higher than 1 (Weight on the Effect of Performance on Demand), Delay in Effect of Performance on demand), DELAY3 (Effect of Performance on Demand for Competitor's Product, Delay in Effect of Performance on demand)))

Units: Dimensionless

Adjusted Effect of Performance on Demand for the New Product =

IF THEN ELSE (Effect of Performance on Demand for the New Product < 1, DELAY3 (Effect of Performance on Demand for the New Product * Table for Adjusting New Product Effect When Lower than 1 (Weight on the Effect of Performance on Demand for the New Product), Delay in Effect of Performance on demand), IF THEN ELSE (Effect of Performance on Demand for the New Product > 1, DELAY3 (Effect of Performance on Demand for the New Product * Table for Adjusting New Product Effect When Higher than 1 (Weight on the Effect of Performance on Demand for the New Product), Delay in Effect of Performance on demand), DELAY3 (Effect of Performance on Demand for the New Product, Delay in Effect of Performance on demand)))

Units: Dimensionless

Adjusted Effect of Performance on Demand for Your Existing Product =

IF THEN ELSE (Effect of Performance on Demand for Your Existing Product < 1, DELAY3 (Effect of Performance on Demand for Your Existing Product * Table for Adjusting Effect When Lower than 1 (Weight on the Effect of Performance on Demand), Delay in Effect of Performance on demand), IF THEN ELSE (Effect of Performance on Demand for Your Existing Product > 1, DELAY3 (Effect of Performance on Demand for Your Existing Product * Table for Adjusting Effect When Higher than 1 (Weight on the Effect of Performance on Demand), Delay in Effect of Performance on demand), DELAY3 (Effect of Performance on Demand for Your Existing Product, Delay in Effect of Performance on demand)))

Units: Dimensionless

Adjusted Effect of Price of Your Existing Product on its Demand =

IF THEN ELSE (Effect of Price of Your Existing Product on its Demand < 1, DELAY3 (Effect of Price of Your Existing Product on its Demand * Table for Adjusting Effect When Lower than 1 (Weight on the Effect of Price on Demand), Delay in Effect of Price on demand), IF THEN ELSE (Effect of Price of Your Existing Product on its Demand > 1, DELAY3 (Effect of Price of Your Existing Product on its Demand * Table for Adjusting Effect When Higher than 1 (Weight on the Effect of Price on Demand), Delay in Effect of Price on demand), DELAY3 (Effect of Price of Your Existing Product on its Demand, Delay in Effect of Price on demand)))

Units: Dimensionless

Adjusted Effect of Price on Demand for Competitor's Product =

IF THEN ELSE (Effect of Price of the Competitor's Product on its Demand < 1, DELAY3 (Effect of Price of the Competitor's Product on its Demand * Table for Adjusting Effect When Lower than 1 (Weight on the Effect of Price on Demand), Delay in Effect of Price on demand), IF THEN ELSE (Effect of Price of the Competitor's Product on its Demand > 1, DELAY3 (Effect of Price of the Competitor's Product on its Demand * Table for Adjusting Effect When Higher than 1 (Weight on the Effect of Price on Demand), Delay in Effect of Price on demand), DELAY3 (Effect of Price of the Competitor's Product on its Demand, Delay in Effect of Price on demand)))

Units: Dimensionless

Adjusted Effect of Price Position of the New Product on its Demand =

IF THEN ELSE (Effect of Price Position of the New Product on its Demand < 1, DELAY3 (Effect of Price Position of the New Product on its Demand * Table for Adjusting New Product Effect When Lower than 1 (Weight on the Effect of Price on Demand for the New Product), Delay in Effect of Price on demand), IF THEN ELSE (Effect of Price Position of the New Product on its Demand > 1, DELAY3 (Effect of Price Position of the New Product on its Demand * Table for Adjusting New Product Effect When Higher than 1 (Weight on the Effect of Price on Demand for the New Product), Delay in Effect of Price on demand), DELAY3 (Effect of Price Position of the New Product on its Demand, Delay in Effect of Price on demand)))

Units: Dimensionless

Adjusted Effect of Risk on Demand for the New Product =

IF THEN ELSE (Effect of Risk on Demand for the New Product < 1, Effect of Risk on Demand for the New Product * Table for Adjusting New Product Effect When Lower than 1 (Weight on the Effect of Risk on Demand for the New Product), IF THEN ELSE (Effect of Risk on Demand for the New Product > 1, Effect of Risk on Demand for the New Product * Table for Adjusting New Product Effect When Higher than 1 (Weight on the Effect of Risk on Demand for the New Product), Effect of Risk on Demand for the New Product))

Units: Dimensionless

Adjusted Effect of Switching Cost on Demand for the New Product =

IF THEN ELSE (Effect of Switching Cost on Demand for the New Product < 1, DELAY3 (Effect of Switching Cost on Demand for the New Product * Table for Adjusting New Product Effect When Lower than 1 (Weight on the Effect of Switching Cost on Demand for the New Product), Delay in Effect of Switching Cost on Demand for the New Product), IF THEN ELSE (Effect of Switching Cost on Demand for the New Product > 1, DELAY3 (Effect of Switching Cost on Demand for the New Product * Table for Adjusting New Product Effect When Higher than 1 (Weight on the Effect of Switching Cost on Demand for the New Product), Delay in Effect of Switching Cost on Demand for the New Product), DELAY3 (Effect of Switching Cost on Demand for the New Product , Delay in Effect of Switching Cost on Demand for the New Product)))

Units: Dimensionless

Adverse Effect on Demand of other Products =

Table for Adverse Effect on Demand Based on Switching Cost of the New Product (Adjusted Effect of Switching Cost on Demand for the New Product)

Units: Dimensionless

Availability of the Competitor's Product = TIME BASE (1000, 0)

Units: Unit/Year [1000,0]

Availability of the Competitor's Product in the marketplace can affect the demand. If real demand is higher than manufacturing and/or distribution ability, actual demand becomes limited. Otherwise, this is not an issue. Default is set to a high value to make this a non-issue.

Availability of the New Product = TIME BASE (50, 500)

Units: Unit/Year [50,500]

Availability of the New Product in the marketplace can affect the demand. If real demand is higher than manufacturing and/or distribution ability, actual demand becomes limited. Otherwise, this is not an issue. Default is set to a high value to make this a non-issue.

Availability of Your Existing Product = TIME BASE (0, 0)

Units: Unit/Year [0,0]

Availability of Your Existing Product in the marketplace can affect the demand. If real demand is higher than manufacturing and/or distribution ability, actual demand becomes limited. Otherwise, this is not an issue. Default is set to a high value to make this a non-issue.

Average Replacement Time = 12

Units: Year

Average time that it takes to replace a unit.

Contribution of Indirect Costs on Switching Cost =

Table to Determine Contribution of Indirect Costs on Switching Cost (Indirect Costs and Risk of Switching)

Units: Dimensionless

The result is a number between -1 and +1, where a negative number means an end-user is discouraged from buying because of high indirect costs associated with switching, and a positive number means an end-user is encouraged because of low indirect switching costs.

Contribution of Minimum Direct Costs on Switching Cost =

Table to Determine Contribution of Minimum Direct Costs on Switching Cost (Minimum Direct Costs as Percent of Unit Price)

Units: Dimensionless

The result is a number between -1 and +1, where a negative number means an end-user is discouraged from buying because of high direct costs associated with switching, and a positive number means an end-user is encouraged because of low direct switching costs.

Contribution of Opportunity Cost on Switching Cost =

Table to Determine Contribution of Opportunity Cost on Switching Cost (Opportunity Cost of Not Switching)

Units: Dimensionless

The result is a number between -1 and +1, where a negative number means an end-user is discouraged from buying because of low opportunity costs associated with switching (no incentives), and a positive number means an end-user is encouraged because of high opportunity costs.

Contribution of Performance Criterion 1 to Demand for the Competitor's Product =

Performance Lookup Table (Performance Criterion 1 for the Competitor's Product) * Weight for Performance Criterion 1

Units: Dimensionless

Contribution of Performance Criterion 1 on Demand for the Competitors' Products is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 1 to Demand for the New Product =

Performance Lookup Table (Performance Criterion 1 for the New Product) * Weight for Performance Criterion 1

Units: Dimensionless

Contribution of Performance Criterion 1 on Demand for the New Product is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 1 to Demand for Your Existing Product =

Performance Lookup Table (Performance Criterion 1 for Your Existing Product) * Weight for Performance Criterion 1

Units: Dimensionless

Contribution of Performance Criterion 1 on Demand for Your Existing Product is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 2 to Demand for the Competitor's Product =

Performance Lookup Table (Performance Criterion 2 for the Competitor's Product) * Weight for Performance Criterion 2

Units: Dimensionless

Contribution of Performance Criterion 2 on Demand for the Competitors' Products is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 2 to Demand for the New Product =

Performance Lookup Table (Performance Criterion 2 for the New Product) * Weight for Performance Criterion 2

Units: Dimensionless

Contribution of Performance Criterion 2 on Demand for the New Product is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 2 to Demand for Your Existing Product =

Performance Lookup Table (Performance Criterion 2 for Your Existing Product) * Weight for Performance Criterion 2

Units: Dimensionless

Contribution of Performance Criterion 2 on Demand for Your Existing Product is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 3 to Demand for the Competitor's Product =

Performance Lookup Table (Performance Criterion 3 for the Competitor's Product) * Weight for Performance Criterion 3

Units: Dimensionless

Contribution of Performance Criterion 3 on Demand for the Competitors' Products is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 3 to Demand for the New Product =

Performance Lookup Table (Performance Criterion 3 for the New Product) * Weight for Performance Criterion 3

Units: Dimensionless

Contribution of Performance Criterion 3 on Demand for the New Product is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 3 to Demand for Your Existing Product =

Performance Lookup Table (Performance Criterion 3 for Your Existing Product) * Weight for Performance Criterion 3

Units: Dimensionless

Contribution of Performance Criterion 3 on Demand for Your Existing Product is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 4 to Demand for the Competitor's Product =

Performance Lookup Table (Performance Criterion 4 for the Competitor's Product) * Weight for Performance Criterion 4

Units: Dimensionless

Contribution of Performance Criterion 4 on Demand for the Competitors' Products is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 4 to Demand for the New Product =

Performance Lookup Table (Performance Criterion 4 for the New Product) * Weight for Performance Criterion 4

Units: Dimensionless

Contribution of Performance Criterion 4 on Demand for the New Product is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 4 to Demand for Your Existing Product =

Performance Lookup Table (Performance Criterion 4 for Your Existing Product) * Weight for Performance Criterion 4

Units: Dimensionless

Contribution of Performance Criterion 4 on Demand for Your Existing Product is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 5 to Demand for the Competitor's Product =

Performance Lookup Table (Performance Criterion 5 for the Competitor's Product) * Weight for Performance Criterion 5

Units: Dimensionless

Contribution of Performance Criterion 5 on Demand for the Competitors' Products is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 5 to Demand for the New Product =

Performance Lookup Table (Performance Criterion 5 for the New Product) * Weight for Performance Criterion 5

Units: Dimensionless

Contribution of Performance Criterion 5 on Demand for the New Product is calculated by quantifying its rating and multiplying it by its weight.

Contribution of Performance Criterion 5 to Demand for Your Existing Product =

Performance Lookup Table (Performance Criterion 5 for Your Existing Product) * Weight for Performance Criterion 5

Units: Dimensionless

Contribution of Performance Criterion 5 on Demand for Your Existing Product is calculated by quantifying its rating and multiplying it by its weight.

Delay in Effect of Brand on demand = 2

Units: Year

Delay in years for Brand to have its effect on demand. Default is 2 years.

Delay in Effect of Performance on demand = 0.5

Units: Year

Delay in years for performance to have its effect on demand. Default is 0.5 years.

Delay in Effect of Price on demand = 0.25

Units: Year

Delay in years for price to have its effect on demand. Default is 0.25 years.

Delay in Effect of Switching Cost on Demand for the New Product = 0.25

Units: Year

Delay in years for switching cost to have its effect on demand. Default is 0.25 years.

Delay in Shortage or Surplus Showing Effect on the Indicated Unit Price = 0.25

Units: Year

This is the delay in years for Shortage or Surplus of the New Product to show any effect on the indicated unit price. For example, this delay may be due to your company's ability to change the price as a result of product shortage or surplus. Default is 0.25 years or by every quarter.

Desired Price Positioning Target = TIME BASE (100, -5)

Units: Dimensionless [100,-5]

This represents the percentage for price premium or price lag for the new product compared to the market leader's price position. Range: -100% to +100%. Default is a premium of 10%. This is based strictly on a competitive price positioning strategy.

Desired Profit Margin = TIME BASE (70, 0)

Units: Dimensionless [70,0]

Desired markup as percentage of unit cost. Default value in 35%.

Desired Unit Price =

$$\text{MAX} ((\text{Desired Unit Price Based on Competitive Positioning} + \text{Desired Unit Price Based on Margin}) / 2, \text{Minimum Unit Price})$$

Units: Dollar/Unit

The desired unit is the highest of the minimum unit price and the average of desired unit prices calculated based on desired margin and competitive positioning. User may choose a better algorithm to set the Desired Unit Price based on desired margin and competitive positioning.

Desired Unit Price Based on Competitive Positioning =

$$\text{Market Leader's Unit Price} * (1 + \text{Desired Price Positioning Target} / 100)$$

Units: Dollar/Unit

Desired unit price based on desired price position with respect to the market leader's pricing.

Desired Unit Price Based on Margin =

$$\text{Unit Cost for the New Product} * (1 + \text{Desired Profit Margin} / 100)$$

Units: Dollar/Unit

Desired unit price based on unit cost and desired profit margin.

Differential Performance Rating Against Competitor's Product =

$$\text{Relative Performance Rating for the New Product} - \text{Relative Performance Rating for the Competitor's Product}$$

Units: Dimensionless

The New Product and the competitor's product are each rated based on five common performance criteria. This is a quantitative measure of how the New Product is compared against the competitor's product. Range: -5 to +5.

Discount Rate = 15

Units: Dimensionless

Effect of Brand on Demand for Competitor's Product =

Table for Effect of Brand on Demand (Percentage of the Market that Favors Your Competitor's Brand)

Units: Dimensionless

Effect of Brand on Demand for Your Products =

Table for Effect of Brand on Demand (Percentage of the Market that Favors Your Company Brand)

Units: Dimensionless

Effect of Market Share on the Indicated Unit Price =

Table for Effect of Market Share on the Indicated Unit Price (Market Share Differential)

Units: Dimensionless

In general, if your actual market share is much higher than your desired market share, the New Product may carry a premium in its price. Reversely, if it is lower, it should be priced lower.

Effect of Performance on Demand for Competitor's Product =

Contribution of Performance Criterion 1 to Demand for the Competitor's Product + Contribution of Performance Criterion 2 to Demand for the Competitor's Product + Contribution of Performance Criterion 3 to Demand for the Competitor's Product + Contribution of Performance Criterion 4 to Demand for the Competitor's Product + Contribution of Performance Criterion 5 to Demand for the Competitor's Product

Units: Dimensionless

Effect of Performance on Demand for the New Product =

Contribution of Performance Criterion 1 to Demand for the New Product + Contribution of Performance Criterion 2 to Demand for the New Product + Contribution of Performance Criterion 3 to Demand for the New Product + Contribution of Performance Criterion 4 to Demand for the New Product + Contribution of Performance Criterion 5 to Demand for the New Product

Units: Dimensionless

Effect of Performance on Demand for Your Existing Product =

Contribution of Performance Criterion 1 to Demand for Your Existing Product + Contribution of Performance Criterion 2 to Demand for Your Existing Product + Contribution of Performance Criterion 3 to Demand for Your Existing Product + Contribution of Performance Criterion 4 to Demand for Your Existing Product + Contribution of Performance Criterion 5 to Demand for Your Existing Product

Units: Dimensionless

Effect of Price of the Competitor's Product on its Demand =

Table for Effect of Price Position on its Demand (Price Position of the Competitor's Product)

Units: Dimensionless

Unit price of the competitor's product relative to the market leader's price will affect the demand for it. A unit price lower than the market leader's price will have a favorable effect.

Effect of Price of Your Existing Product on its Demand =

Table for Effect of Price Position on its Demand (Price Position of Your Existing Product)

Units: Dimensionless

Unit price of your existing product relative to the market leader's price will affect the demand for it. A unit price lower than the market leader's price will have a favorable effect.

Effect of Price Position of the New Product on its Demand =

Table for Effect of Price Position on its Demand (Price Position of the New Product)

Units: Dimensionless

Unit price of the New Product relative to the market leader's price will affect the demand for it. A unit price lower than the market leader's price will have a favorable effect.

Effect of Relative Performance on the Indicated Unit Price =

Table for Effect of Relative Performance on the Indicated Unit Price (Differential Performance Rating Against Competitor's Product)

Units: Dimensionless

In general, if the New Product is rated higher in performance than the competitor's product, it may carry a premium in price. Reversely, if it is rated lower, it should be priced lower.

Effect of Risk on Demand for the New Product = Risk / Normalize Factor

Units: Dimensionless

Effect of Shortage or Surplus on the Indicated Unit Price =

DELAY FIXED (Table for Effect of Shortage or Surplus on the Indicated Unit Price (Shortage or Surplus Measure) , Delay in Shortage or Surplus Showing Effect on the Indicated Unit Price, 1.1)

Units: Dimensionless

Initial condition assumes shortage.

Effect of Switching Cost on Demand for the New Product =

IF THEN ELSE ((1 + Contribution of Indirect Costs on Switching Cost + Contribution of Minimum Direct Costs on Switching Cost + Contribution of Opportunity Cost on Switching Cost) < 0, 0.001, 1 + Contribution of Indirect Costs on Switching Cost + Contribution of Minimum Direct Costs on Switching Cost + Contribution of Opportunity Cost on Switching Cost)

Units: Dimensionless

The starting point is 1 where switching cost has no effect on demand. Direct costs, indirect costs and opportunity cost each increase or decrease the starting point. As this number increases, there is more demand. Vice versa, as it decreases, there is less demand.

Effect of Your Brand on the Indicated Unit Price =

Table for Effect of Your Brand on Indicated Unit Price (Percentage of the Market that Favors Your Company Brand)

Units: Dimensionless

In general, if a high percentage of the market favorably recognize your brand, the indicated price of the New Product may carry a premium while reversely, if a low percentage of the market favorably recognize your brand, the New Product should be priced lower to attract more customers.

Expected Market Growth = Replacement Rate * Table for Market Growth (Time) / 100

Units: Unit/Year

Market Growth is based on the growth percentage indicated in the Table for Market Growth.

Expected Market Growth due to New Applications and Uses =

Replacement Rate * Table for Incremental Market Growth (Time) / 100

Units: Unit/Year

The New Product may create new applications or uses for the product that did not exist with the older generations of this product. In this case, a new segment of the market becomes available for the New Product.

FINAL TIME = 20

Units: Year

The final time for the simulation.

Incremental Demand for the New Product =

Expected Market Growth due to New Applications and Uses

Units: Unit/Year

Indicated Unit Price for the New Product =

Desired Unit Price * Effect of Market Share on the Indicated Unit Price * Effect of Relative Performance on the Indicated Unit Price * Effect of Shortage or Surplus on the Indicated Unit Price * Effect of Your Brand on the Indicated Unit Price

Units: Dollar/Unit

Indicated unit price is the desired unit price after considering the effect of market share position, relative performance, shortage or surplus, and brand.

Indirect Costs and Risk of Switching = TIME BASE (10, -0.35)

Units: Dimensionless [10,-0.35]

A number between 0 and 10, where 0 represents no indirect cost and no risk in switching from an old product to the New Product, and 10 represents very high indirect costs and very high risks. Such indirect costs and risks are associated with possible loss of productivity during switching which may result in loss of customers and/or sales for the end-user. Many factors contribute to this cost and most of them are very subtle. For example, the New Product may require a different workflow or method of production that may not be necessarily obvious. Default value is 1.

INITIAL TIME = 0

Units: Year

The initial time for the simulation.

Initial Unit Cost = TIME BASE (140000, 0)

Units: Dollar/Unit [140000,0]

Initial unit cost assessed on the New Product - should include all costs (manufacturing, sales, service, etc.).

Installed Base =

Installed Base for Competitor's Product + Installed Base for Other Products + Your Installed Base

Units: Unit

Total size of the installed base for all products.

Installed Base for Competitor's Product =

INTEG (Sales Rate for Competitor's Product - Replacement Rate for Competitor's Product, Past Sales of Competitor's Product)

Units: Unit

Installed Base for Other Products =

INTEG(Sales Rate for Other Products - Replacement Rate for Other Products, Past Sales of Other Products)

Units: Unit

Installed Base for the New Product =

INTEG (Sales Rate for the New Product - Replacement Rate for the New Product, 0)

Units: Unit

Installed Base for Your Existing Product =

INTEG (Sales Rate for Your Existing Product - Replacement Rate for Your Existing Product ,Past Sales of Your Existing Product)

Units: Unit

Margin Rate from Sales of Additional Products and Services =

Margins on Additional Products and Services Sold per New Product Unit * Sales Rate for the New Product / ((1 + (Discount Rate / 100)) ^ Year of Event)

Units: Dollar/Year

Margins on Additional Products and Services Sold per New Product Unit = 1

Units: Dollar/Unit

Market Leader's Unit Price = TIME BASE (95000, 0)

Units: Dollar/Unit [95000,0]

This is the market leader's unit price used as a benchmark for competitive pricing.

Market Share = Your Installed Base * 100 / Installed Base

Units: Dimensionless

Market share of your products (existing and new) as a percentage of the whole installed base.

Market Share Differential = Market Share-Target Market Share

Units: Dimensionless

Differential in actual market share against to the desired market share. Theoretical range: -100 to +100.

Minimum Direct Costs as Percent of Unit Price = TIME BASE (40, -0.75)

Units: Dimensionless [40,-0.75]

Direct Costs include costs associated with installation of the New Product, removal of any old products, training costs, etc. it is measured against Unit price of the New Product. Default value is 30% which is assumed to be reasonable and have no affect on demand. This value may be changed as required.

Minimum Required Profit Margin = 25

Units: Dimensionless

Minimum Unit Price =

Unit Cost for the New Product * (1 + Minimum Required Profit Margin / 100)

Units: Dollar/Unit

New Technology Rated for its Ability to be Delivered to Market On Time = 70

Units: Dimensionless

Select a rating from 0 to 100, where 100 indicates 100 percent confidence that the new technology can be manufactured in a cost effective way. Default value for this variable is 100.

New Technology Rated for its Newness in Technical Sense = 50

Units: Dimensionless

Select a rating from 0 to 100, where 100 indicates 100 percent confidence that the new technology has a proven technical track. Note the reverse rating. Default value for this variable is 100.

New Technology Rated for its Newness to Any Market = 80

Units: Dimensionless

Select a rating from 0 to 100, where 100 indicates 100 percent confidence that the new technology has been proven in at least one other market. Note the reverse rating. Default value for this variable is 100.

New Technology Rated for its Newness to Targeted Market = 20

Units: Dimensionless

Select a rating from 0 to 100, where 100 indicates 100 percent confidence that the new technology has been proven in the targeted market. Note the reverse rating. Default value for this variable is 100.

Normalize Factor = 100

Units: Dimensionless

NPV for the New Product = INTEG (NPV Rate for the New Product, 0)

Units: Dollar

NPV from Additional Products and Services =

INTEG (Margin Rate from Sales of Additional Products and Services , 0)

Units: Dollar

NPV Rate for the New Product =

$$\frac{(\text{Profit per Unit of New Product Sold} * \text{Sales Rate for the New Product})}{((1 + (\text{Discount Rate} / 100))^{\text{Year of Event}})}$$

Units: Dollar/Year

One Year Step = 1

Units: Year

Opportunity Cost of Not Switching = TIME BASE (2, 0.1)

Units: Dimensionless [2,0.1]

A number between 0 and 10, where 0 represents no opportunity cost if end-user does not switch from an old product to the New Product, and 10 represents a very high opportunity cost. Default value is 0.

Past Sales of Competitor's Product = 6000

Units: Unit

This is the initial value for installed base portion made up of the competitor's products.

Past Sales of Other Products = 2000

Units: Unit

Past Sales of Your Existing Product = 100

Units: Unit

Percentage of the Market that Favors Your Company Brand = TIME BASE (40, 0)

Units: Dimensionless [40,0]

A number from 0 - 100 indicating the percentage of the market favorably recognizing your company's brand. Default is 40.

Percentage of the Market that Favors Your Competitor's Brand = TIME BASE (30, 0)

Units: Dimensionless [30,0]

A number from 0 - 100 indicating the percentage of the market favorably recognizing competitor's brand. Default is 30.

Performance Criterion 1 for the Competitor's Product = 2

Units: Dimensionless

Considering the Competitors' Products, performance criterion 1 is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 1 for the New Product = 5

Units: Dimensionless

Considering the New Product, performance criterion 1 is rated from 1 to 5, where 5 suggests that relative to competitive and existing products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 1 for Your Existing Product = 2

Units: Dimensionless

Considering Your Existing Product, performance criterion 1 is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 2 for the Competitor's Product = 4

Units: Dimensionless

Considering the Competitors' Products, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 2 for the New Product = 3

Units: Dimensionless

Considering the New Product, performance criterion 2 is rated from 1 to 5, where 5 suggests that relative to competitive and existing products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 2 for Your Existing Product = 4

Units: Dimensionless

Considering Your Existing Product, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 3 for the Competitor's Product = 2

Units: Dimensionless

Considering the Competitors' Products, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 3 for the New Product = 5

Units: Dimensionless

Considering the New Product, performance criterion 3 is rated from 1 to 5, where 5 suggests that relative to competitive and existing products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 3 for Your Existing Product = 1

Units: Dimensionless

Considering Your Existing Product, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 4 for the Competitor's Product = 1

Units: Dimensionless

Considering the Competitors' Products, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 4 for the New Product = 5

Units: Dimensionless

Considering the New Product, performance criterion 4 is rated from 1 to 5, where 5 suggests that relative to competitive and existing products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 4 for Your Existing Product = 1

Units: Dimensionless

Considering Your Existing Product, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 5 for the Competitor's Product = 2

Units: Dimensionless

Considering the Competitors' Products, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 5 for the New Product = 5

Units: Dimensionless

Considering the New Product, performance criterion 5 is rated from 1 to 5, where 5 suggests that relative to competitive and existing products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Criterion 5 for Your Existing Product = 1

Units: Dimensionless

Considering Your Existing Product, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.

Performance Lookup Table ([(0,0)-(5,1.2)],(1,0.3),(2,0.8),(3,1),(4,1.05),(5,1.1))

Units: Dimensionless

For performance ratings of 5, 4, 3, 2, and 1, quantification values are 1.1, 1.05, 1.0, 0.95, and 0.9, respectively. These values may be changed for a more suitable set of values.

Potential Demand = Replacement Rate + Expected Market Growth

Units: Unit/Year

Potential Demand is based on demand generated due to replacement needs plus demand generated due to market growth.

Potential Demand for the New Product = Potential Demand + Incremental Demand for the New Product

Units: Unit/Year

Present Value of Capital Investments Related to Sales of Additional Products and Services = 0

Units: Dimensionless

This represents the present value of all investments related to the new product that leads to sales of additional products and services.

Present Value of the New Product Commercialization and Other Capital Investments = 10000000

Units: Dimensionless

Price Position of the Competitor's Product =

IF THEN ELSE (Market Leader's Unit Price = 0, Unit Price for the Competitor's Product * 100 / (Market Leader's Unit Price + 0.0001) , Unit Price for the Competitor's Product * 100 / Market Leader's Unit Price)

Units: Dimensionless

This represents the indicated price as a percentage of the market leader's unit price. Range: 0% to 1000%.

Price Position of the New Product =

IF THEN ELSE (Market Leader's Unit Price = 0, Unit Price for the New Product * 100 / (Market Leader's Unit Price + 0.0001) , Unit Price for the New Product* 100 / Market Leader's Unit Price)

Units: Dimensionless

This represents the indicated price as a percentage of the market leader's unit price. Range: 0% to 1000%.

Price Position of Your Existing Product =

IF THEN ELSE (Market Leader's Unit Price=0,Unit Price for Your Existing Product*100/(Market Leader's Unit Price+0.0001),Unit Price for Your Existing Product*100/Market Leader's Unit Price)

Units: Dimensionless

This represents the indicated price as a percentage of the market leader's unit price. Range: 0% to 1000%.

Profit per Unit of New Product Sold = Unit Price for the New Product - Unit Cost for the New Product

Units: Dollar/Unit

Relative Performance Rating for the Competitor's Product =

Performance Criterion 1 for the Competitor's Product * Weight for Performance Criterion 1 +
Performance Criterion 2 for the Competitor's Product * Weight for Performance Criterion 2 +
Performance Criterion 3 for the Competitor's Product * Weight for Performance Criterion 3 +
Performance Criterion 4 for the Competitor's Product * Weight for Performance Criterion 4 +
Performance Criterion 5 for the Competitor's Product * Weight for Performance Criterion 5

Units: Dimensionless

Weighted rating for the performance of the Competitor's product relative to other products. Should result in a number in the range of 0 to 5.

Relative Performance Rating for the New Product =

Performance Criterion 1 for the New Product * Weight for Performance Criterion 1 + Performance
Criterion 2 for the New Product * Weight for Performance Criterion 2 + Performance Criterion 3 for
the New Product * Weight for Performance Criterion 3 + Performance Criterion 4 for the New Product
* Weight for Performance Criterion 4 + Performance Criterion 5 for the New Product * Weight for
Performance Criterion 5

Units: Dimensionless

Weighted rating for the performance of the New product relative to other products. Should result in a number in the range of 0 to 5.

Replacement Rate =

Replacement Rate for Competitor's Product + Replacement Rate for Other Products + Your
Replacement Rate

Units: Unit/Year

Replacement Rate for Competitor's Product =

Installed Base for Competitor's Product / Average Replacement Time

Units: Unit/Year

Replacement Rate for Other Products =

Installed Base for Other Products / Average Replacement Time

Units: Unit/Year

Replacement Rate for the New Product =

Installed Base for the New Product / Average Replacement Time

Units: Unit/Year

Replacement Rate for Your Existing Product =

$$\text{Installed Base for Your Existing Product} / \text{Average Replacement Time}$$

Units: Unit/Year

Risk =

$$\begin{aligned} & \text{New Technology Rated for its Ability to be Delivered to Market On Time} * \text{Weight for Ability to be} \\ & \text{Delivered to Market On Time} + \text{Was There a Successful Feasibility Test Performed on this New} \\ & \text{Technology as a Measure of Reliability} * \text{Weight for a Successful Feasibility Test} + \text{New Technology} \\ & \text{Rated for its Newness in Technical Sense} * \text{Weight for Technical Newness} + \text{New Technology Rated} \\ & \text{for its Newness to Targeted Market} * \text{Weight for Target Market Newness} + \text{New Technology Rated for} \\ & \text{its Newness to Any Market} * \text{Weight for Newness in All Markets} \end{aligned}$$

Units: Dimensionless

A value in the range of 0 to 100 will be calculated here to quantify Risk. 100 indicates no risk while 0 indicates a prediction for complete technical failure. Using default values results in a default value of 100 for this variable. Note all weights must add to 1.

Sales Rate for Competitor's Product =

$$\text{IF THEN ELSE } ((\text{Potential Demand} * \text{Total Adjusted Effects for Competitor's Product}) \leq \text{Availability of the Competitor's Product}, \text{Potential Demand} * \text{Total Adjusted Effects for Competitor's Product}, \text{Availability of the Competitor's Product})$$

Units: Unit/Year

Nominal demand is the same as Potential demand. Factors that affect the nominal demand are the relative Price, Performance and Brand of the competitive products.

Sales Rate for Other Products =

$$\text{MAX}(\text{Potential Demand for the New Product-Sales Rate for Competitor's Product-Sales Rate for the New Product-Sales Rate for Your Existing Product}, 0)$$

Units: Unit/Year

Balance of Potential Demand not used for the New Product, your existing product, and the competitor's product.

Sales Rate for the New Product =

$$\text{IF THEN ELSE } (\text{Potential Demand for the New Product} * \text{Total Adjusted Effects for the New Product} \leq \text{Availability of the New Product}, \text{Potential Demand for the New Product} * \text{Total Adjusted Effects for the New Product}, \text{Availability of the New Product})$$

Units: Unit/Year

Sales Rate for Your Existing Product =

IF THEN ELSE ((Potential Demand * Total Adjusted Effects for Your Existing Product) <= Availability of Your Existing Product , Potential Demand * Total Adjusted Effects for Your Existing Product, Availability of Your Existing Product)

Units: Unit/Year

Nominal demand is the same as Potential demand. Factors that affect the nominal demand are the relative Price, Performance and Brand of the existing product.

SAVEPER = TIME STEP

Units: Year

The frequency with which output is stored.

Sell Below Minimum Unit Price Policy = 0

Units: Dimensionless

If sales below Minimum Unit Price is allowed, this variable should be set to 1; otherwise, it should be zero.

Shortage or Surplus Measure =

IF THEN ELSE (Availability of the New Product > 0, Availability of the New Product * 100 / Potential Demand for the New Product, Availability of the New Product * 100 / (Potential Demand for the New Product + 0.0001))

Units: Unit/Year

This represents the product availability as a percentage of demand. On one hand, availability may be limited due to manufacturing or distribution, thus create a shortage or backlog. On the other hand, it may exceed demand and create a surplus. Range may exceed 100.

**Table for Adjusting Effect When Higher than 1 ((0,1)-(100,1.2)],(0,1),(20,1),(30,1.005),
(40,1.01),(50,1.02),(60,1.03),(70,1.04),(80,1.05),(90,1.07),(100,1.1))**

Units: Dimensionless

The effect of different factors on demand of different products is adjusted using this lookup table. This table is only used for those effects that are higher than 1. The adjustment is done as a function of the weight of the effect. The higher the weight, the effect will be more exaggerated.

**Table for Adjusting Effect When Lower than 1 ([0,0)-(100,1)],(0,1),(20,1),(30,0.99),(40,0.98)
,(50,0.96),(60,0.94),(70,0.91),(80,0.87),(90,0.82),(100,0.75))**

Units: Dimensionless

The effect of different factors on demand of different products is adjusted using this lookup table. This table is only used for those effects that are lower than 1. The adjustment is done as a function of the weight of the effect. The higher the weight, the effect will be more exaggerated.

Table for Adjusting New Product Effect When Higher than 1 ([(0,1)-(100,1.2)],(0,1),(20,1)

, (30,1.01),(40,1.01),(50,1.02),(60,1.03),(70,1.04),(80,1.05),(90,1.07),(100,1.1))

Units: Dimensionless

The effect of different factors on demand of the New Product is adjusted using this lookup table. This table is only used for those effects that are higher than 1. The adjustment is done as a function of the weight of the effect. The higher the weight, the effect will be more exaggerated.

Table for Adjusting New Product Effect When Lower than 1 ([(0,0)-(100,1)],(0,1),(20,0.98)

, (30,0.95),(40,0.9),(50,0.84),(60,0.78),(70,0.71),(80,0.63),(90,0.52),(100,0.4))

Units: Dimensionless

The effect of different factors on demand of the New Product is adjusted using this lookup table. This table is only used for those effects that are lower than 1. The adjustment is done as a function of the weight of the effect. The higher the weight, the effect will be more exaggerated.

Table for Adverse Effect on Demand Based on Switching Cost of the New Product ([(0,0)-(2,1)],

(0,1),(0.1,0.99),(0.2,0.99),(0.3,0.98),(0.4,0.96),(0.5,0.89),(0.6,0.75),(0.7,0.59)

, (0.8,0.51),(0.9,0.44),(1,0.4),(2,0.3))

Units: Dimensionless

Table for Effect of Brand on Demand ([(0,0)-(100,1.25)],(0,0.05),(25,0.65),(50,0.9),(75,1.05)

, (100,1.12))

Units: Dimensionless

This table should be adjusted according to user's discretion. The default table shows a linear effect of 0.75 to 1.25 for zero percent brand recognition to 100 percent brand recognition, respectively. Note that at 50 percent, where possibly both your brand and competitor's brand may be favorably recognized equally high, the effect is 1 (no effect on demand).

Table for Effect of Market Share on the Indicated Unit Price ([(-100,0.75)-(100,1.25)],(-100,0.75)

, (0,1),(100,1.25))

Units: Dimensionless

Table for Effect of Price Position on its Demand ([(0,0)-(10000,1.25)],(0,1.2),(50,1.15),

(80,1.06),(90,1.03),(100,1),(110,0.95),(120,0.85),(150,0.6),(200,0.5),(10000,0.02))

Units: Dimensionless

Table for Effect of Relative Performance on the Indicated Unit Price ([(-5,0.75)-(5,1.25)],

(-5,0.75),(0,1),(5,1.25))

Units: Dimensionless

**Table for Effect of Shortage or Surplus on the Indicated Unit Price ((0,0)-(10000,1.25)),
(0,1.25),(10,1.2),(20,1.15),(30,1.1),(40,1.07),(50,1.05),(60,1.04),(70,1.03),(80,1.02),
(90,1.01),(100,1),(110,0.99),(150,0.95),(200,0.9),(300,0.8),(10000,0.1))**

Units: Dimensionless

**Table for Effect of Your Brand on Indicated Unit Price ((0,0)-(100,1.2)],(0,0.6),(50,1),
(75,1.1),(100,1.2))**

Units: Dimensionless

Table for Incremental Market Growth ((0,0)-(20,2000)],(0,0),(1,1),(10,2),(20,5))

Units: Dimensionless

Table for Market Growth ((0,0)-(20,10)],(0,2),(1,2),(10,2),(20,2))

Units: Dimensionless

**Table of Percentage Cost Reduction as a Function of Sales Volume ((0,0)-(1e+006,100)],(0,0),
(500,3),(700,5),(1000,10),(1e+006,30))**

Units: Dimensionless

As more and more units are manufactured, cost is reduced. This table shows a schedule of such cost reduction in terms of percentage.

**Table to Determine Contribution of Indirect Costs on Switching Cost ((0,-0.6)-(10,0.1)],
(0,0.05),(1,0),(2,-0.02),(3,-0.04),(4,-0.06),(5,-0.1),(6,-0.14),(7,-0.18),(8,-0.24),
(9,-0.3),(10,-0.4))**

Units: Dimensionless

This table determines the contribution of indirect costs or risk of switching. If indirect costs are rated 1, the contribution is null. Below 1, an end-user finds it encouraging to switch. However, as the rating increases above 1, an end-user is increasingly discouraged to switch.

**Table to Determine Contribution of Minimum Direct Costs on Switching Cost ((0,-1)-(10000,1)],
(0,0.25),(10,0.08),(20,0),(30,-0.04),(40,-0.09),(50,-0.15),(60,-0.2),(70,-0.3),
(80,-0.38),(90,-0.45),(100,-0.5),(10000,-0.99))**

Units: Dimensionless

This table determines the contribution that direct costs have on the total switching cost. If direct costs are 30% of the unit price of the New Product, it has no affect. Below 30%, it has positive affect; meaning that direct costs of less than 30% of the unit price help an end-user to switch. However, as direct costs rise above 30%, an end-user gets discouraged to switch.

Table to Determine Contribution of Opportunity Cost on Switching Cost ((0,0)-(10,1)),(0,0)

**,(1,0.005),(2,0.01),(3,0.02),(4,0.03),(5,0.05),(6,0.07),(7,0.09),(8,0.12),(9,0.15)
,(10,0.2))**

Units: Dimensionless

This table determines the contribution of opportunity cost of not switching. If opportunity cost is rated 0, the contribution is null. As the rating increases above 1, an end-user is increasingly encouraged to switch to avoid increasing cost of opportunity.

Target Market Share = TIME BASE (10, 2)

Units: Dimensionless [10,2]

Desired market share including your existing product as well as your New Product represented as a percentage value.

TIME STEP = 0.015625

Units: Year

The time step for the simulation.

• Total Adjusted Effects for Competitor's Product =

Adjusted Effect of Brand on Demand for Competitor's Product * Adjusted Effect of Performance on Demand for Competitor's Product * Adjusted Effect of Price on Demand for Competitor's Product * Adverse Effect on Demand of other Products

Units: Dimensionless

Total Adjusted Effects for the New Product =

Adjusted Effect of Brand on Demand for the New Product * Adjusted Effect of Performance on Demand for the New Product * Adjusted Effect of Price Position of the New Product on its Demand * Adjusted Effect of Risk on Demand for the New Product * Adjusted Effect of Switching Cost on Demand for the New Product

Units: Dimensionless

Total Adjusted Effects for Your Existing Product =

Adjusted Effect of Brand on Demand for Your Products * Adjusted Effect of Performance on Demand for Your Existing Product * Adjusted Effect of Price of Your Existing Product on its Demand * Adverse Effect on Demand of other Products

Units: Dimensionless

Unit Cost for the New Product =

(1 - Table of Percentage Cost Reduction as a Function of Sales Volume (Installed Base for the New Product) / 100) * Initial Unit Cost

Units: Dollar/Unit

Cost per unit of the New Product should include all costs (manufacturing, sales, service, etc.).

Unit Price for the Competitor's Product = TIME BASE (95000, 0)

Units: Dollar/Unit [95000,0]

Average unit price charged for competitor's product sold.

Unit Price for the New Product =

IF THEN ELSE (Indicated Unit Price for the New Product >= Minimum Unit Price , Indicated Unit Price for the New Product , IF THEN ELSE (Sell Below Minimum Unit Price Policy = 0, Minimum Unit Price , Indicated Unit Price for the New Product))

Units: Dollar/Unit

If the Indicated Unit Price is greater or equal to Minimum Unit Price, use the Indicated Unit Price. If the Indicated Unit Price is less than the Unit Cost and it is not allowed to sell below cost, set Unit Price to Minimum Unit Price. If it is allowed to sell below cost, set Unit Price to the Indicated Unit Price.

Was There a Successful Feasibility Test Performed on this New Technology as a Measure of Reliability = 60

Units: Dimensionless

Select a rating from 0 to 100, where 100 indicates 100 percent confidence that the new technology has been found completely feasible. Default value for this variable is 100.

Weight for a Successful Feasibility Test = TIME BASE (0.4, -0.01)

Units: Dimensionless [0.4,-0.01]

This value is used as a weight for the variable "Was There a Successful Feasibility Test Performed on this New Technology?" It indicates the relative importance of this variable compared to other variables used for quantifying risk. Default value for this variable is 0.2. Acceptable range is from 0 to 1. Note that all weights for risk variables have to add up to 1.

Weight for Ability to be Delivered to Market On Time = TIME BASE (0.4, -0.01)

Units: Dimensionless [0.4,-0.01]

This value is used as a weight for the variable "New Technology Rated for its Ability to be Delivered to Market On Time". It indicates the relative importance of this variable compared to other variables used for quantifying risk. Default value for this variable is 0.2. Acceptable range is from 0 to 1. Note that all weights for risk variables have to add up to 1.

Weight for Newness in All Markets = TIME BASE (0.05, 0.0075)

Units: Dimensionless [0.05,0.0075]

This value is used as a weight for the variable "New Technology Rated for its Newness to Any Market". It indicates the relative importance of this variable compared to other variables used for quantifying risk. Default value for this variable is 0.2. Acceptable range is from 0 to 1. Note that all weights for risk variables have to add up to 1.

Weight for Performance Criterion 1 = 0.25

Units: Dimensionless

This is a measure of importance for Performance Criterion 1 as compared to other performance criteria. Default is 20% for equal rating for each of the five performance criteria.

Weight for Performance Criterion 2 = 0.25

Units: Dimensionless

This is a measure of importance for Performance Criterion 2 as compared to other performance criteria. Default is 20% for equal rating for each of the five performance criteria.

Weight for Performance Criterion 3 = 0.15

Units: Dimensionless

This is a measure of importance for Performance Criterion 3 as compared to other performance criteria. Default is 20% for equal rating for each of the five performance criteria.

Weight for Performance Criterion 4 = 0.15

Units: Dimensionless

This is a measure of importance for Performance Criterion 4 as compared to other performance criteria. Default is 20% for equal rating for each of the five performance criteria.

Weight for Performance Criterion 5 = 0.2

Units: Dimensionless

This is a measure of importance for Performance Criterion 5 as compared to other performance criteria. Default is 20% for equal rating for each of the five performance criteria.

Weight for Target Market Newness = TIME BASE (0.05, 0.0075)

Units: Dimensionless [0.05,0.0075]

This value is used as a weight for the variable "New Technology Rated for its Newness to Targeted Market". It indicates the relative importance of this variable compared to other variables used for quantifying risk. Default value for this variable is 0.2. Acceptable range is from 0 to 1. Note that all weights for risk variables have to add up to 1.

Weight for Technical Newness = TIME BASE (0.1, 0.005)

Units: Dimensionless [0.1,0.005]

This value is used as a weight for the variable "New Technology Rated for its Newness in Technical Sense". It indicates the relative importance of this variable compared to other variables used for quantifying risk. Default value for this variable is 0.2. Acceptable range is from 0 to 1. Note that all weights for risk variables have to add up to 1.

Weight on the Effect of Brand on Demand = 15

Units: Dimensionless

Weight factor indicates importance that Brand has on Demand. Note that the weight factors for the different factors that affect the demand of a product must add up to 100. Range: 0 - 100. Default value is 15%.

Weight on the Effect of Brand on Demand for the New Product = TIME BASE (3, 0.6)

Units: Dimensionless [3,0.6]

Weight factor indicates importance that Brand has on Demand for the New Product. Note that the weight factors for the different factors that affect the demand of the New Product must add up to 100. Range: 0 - 100.

Weight on the Effect of Performance on Demand = 40

Units: Dimensionless

Weight factor indicates importance that Performance has on Demand. Note that the weight factors for the different factors that affect the demand of a product must add up to 100. Range: 0 - 100. Default value is 40%.

Weight on the Effect of Performance on Demand for the New Product = TIME BASE (5, 1.75)

Units: Dimensionless [5,1.75]

Weight factor indicates importance that Performance has on Demand for the New Product. Note that the weight factors for the different factors that affect the demand of the New Product must add up to 100. Range: 0 - 100. Default value is 35%.

Weight on the Effect of Price on Demand = 45

Units: Dimensionless

Weight factor indicates importance that Price has on Demand. Note that the weight factors for the different factors that affect the demand of a product must add up to 100. Range: 0 - 100. Default value is 45%.

Weight on the Effect of Price on Demand for the New Product = TIME BASE (2, 2.15)

Units: Dimensionless [2,2.15]

Weight factor indicates importance that Price has on Demand for the New Product. Note that the weight factors for the different factors that affect the demand of the New Product must add up to 100. Range: 0 - 100. Default value is 35%.

Weight on the Effect of Risk on Demand for the New Product = TIME BASE (45, -2.25)

Units: Dimensionless [45,-2.25]

Weight factor indicates importance that Risk has on Demand for the New Product. Note that the weight factors for the different factors that affect the demand of the New Product must add up to 100. Range: 0 - 100. Default value is 20%.

Weight on the Effect of Switching Cost on Demand for the New Product = TIME BASE (45, -2.25)

Units: Dimensionless [45,-2.25]

Weight factor indicates importance that Switching Cost has on Demand for the New Product. Note that the weight factors for the different factors that affect the demand of the New Product must add up to 100. Range: 0 - 100. Default value is 50%.

Year of Event = INTEGER (Time)

Units: Dimensionless

Your Installed Base =

Installed Base for the New Product + Installed Base for Your Existing Product

Units: Unit

Your Replacement Rate =

Replacement Rate for the New Product + Replacement Rate for Your Existing Product

Units: Unit/Year

APPENDIX C -- INPUT FORM

The following form is used for capturing input data for the model. The form is divided into ten sections and requires 88 input values.

1. Simulation Time

Data related to simulation timing.

No.	Input, Unit & Description	Value
1	INITIAL TIME Units: Year The initial time for the simulation.	
2	FINAL TIME Units: Year The final time for the simulation.	
3	TIME STEP Units: Year The time step for the simulation. The time step must less than quarter of the smallest delay in the model.	

2. Market and Adjustment Effects

Data related market sensitivities and adjustments of factors based on market sensitivities. Also, includes market specific data like average replacement time for products and market growth estimates.

No.	Input & Description	Value
4	Average Replacement Time Units: Year Average time that it takes to replace a unit.	
5	Delay in Effect of Brand on demand Units: Year Delay in years for Brand to have its effect on demand. Default is 2 years.	
6	Delay in Effect of Performance on demand Units: Year Delay in years for performance to have its effect on demand. Default is 0.5 years.	
7	Delay in Effect of Price on demand Units: Year Delay in years for price to have its effect on demand. Default is 0.25 years.	
8	Delay in Effect of Switching Cost on Demand for the New Product Units: Year Delay in years for switching cost to have its effect on demand. Default is 0.25 years.	
9	Delay in Shortage or Surplus Showing Effect on the Indicated Unit Price Units: Year This is the delay in years for Shortage or Surplus of the New Product to show any effect on the indicated unit price. For example, this delay may be due to your company's ability to change the price as a result of product shortage or surplus. Default is 0.25 years or by every quarter.	
10	Table for Adjusting Effect When Higher than 1 Units: Dimensionless The effect of different factors on demand of different products is adjusted using this lookup table. This table is only used for those effects that are higher than 1. The adjustment is done as a function of the weight of the effect. The higher the weight, the effect will be more exaggerated.	
11	Table for Adjusting Effect When Lower than 1 Units: Dimensionless The effect of different factors on demand of different products is adjusted using this lookup table. This table is only used for those effects that are lower than 1. The adjustment is done as a function of the weight of the effect. The higher the weight, the effect will be more exaggerated.	

No.	Input & Description	Value
12	Table for Adjusting New Product Effect When Higher than 1 Units: Dimensionless The effect of different factors on demand of the New Product is adjusted using this lookup table. This table is only used for those effects that are higher than 1. The adjustment is done as a function of the weight of the effect. The higher the weight, the effect will be more exaggerated.	
13	Table for Adjusting New Product Effect When Lower than 1 Units: Dimensionless The effect of different factors on demand of the New Product is adjusted using this lookup table. This table is only used for those effects that are lower than 1. The adjustment is done as a function of the weight of the effect. The higher the weight, the effect will be more exaggerated.	
14	Table for Incremental Market Growth Units: Dimensionless	
15	Table for Market Growth Units: Dimensionless	
16	Target Market Share Units: Dimensionless Desired market share including your existing product as well as your New Product represented as a percentage value.	
17	Weight on the Effect of Brand on Demand Units: Dimensionless Weight factor indicates importance that Brand has on Demand. Note that the weight factors for the different factors that affect the demand of a product must add up to 100. Range: 0 - 100. Default value is 15%.	
18	Weight on the Effect of Brand on Demand for the New Product Units: Dimensionless Weight factor indicates importance that Brand has on Demand for the New Product. Note that the weight factors for the different factors that affect the demand of the New Product must add up to 100. Range: 0 - 100.	
19	Weight on the Effect of Performance on Demand Units: Dimensionless Weight factor indicates importance that Performance has on Demand. Note that the weight factors for the different factors that affect the demand of a product must add up to 100. Range: 0 - 100. Default value is 40%.	
20	Weight on the Effect of Performance on Demand for the New Product Units: Dimensionless Weight factor indicates importance that Performance has on Demand for the New Product. Note that the weight factors for the different factors that affect the demand of the New Product must add up to 100. Range: 0 - 100. Default value is 35%.	

No.	Input & Description	Value
21	<p>Weight on the Effect of Price on Demand</p> <p>Units: Dimensionless</p> <p>Weight factor indicates importance that Price has on Demand. Note that the weight factors for the different factors that affect the demand of a product must add up to 100. Range: 0 - 100. Default value is 45%.</p>	
22	<p>Weight on the Effect of Price on Demand for the New Product</p> <p>Units: Dimensionless</p> <p>Weight factor indicates importance that Price has on Demand for the New Product. Note that the weight factors for the different factors that affect the demand of the New Product must add up to 100. Range: 0 - 100. Default value is 35%.</p>	
23	<p>Weight on the Effect of Risk on Demand for the New Product</p> <p>Units: Dimensionless</p> <p>Weight factor indicates importance that Risk has on Demand for the New Product. Note that the weight factors for the different factors that affect the demand of the New Product must add up to 100. Range: 0 - 100. Default value is 20%.</p>	
24	<p>Weight on the Effect of Switching Cost on Demand for the New Product</p> <p>Units: Dimensionless</p> <p>Weight factor indicates importance that Switching Cost has on Demand for the New Product. Note that the weight factors for the different factors that affect the demand of the New Product must add up to 100. Range: 0 - 100. Default value is 50%.</p>	

3. Availability

Data indicating limits on availability of products. These limits may be related to manufacturing capacity or distribution ability.

No.	Input, Unit & Description	Value
25	Availability of the Competitor's Product Units: Unit/Year Availability of the Competitor's Product in the marketplace can affect the demand. If real demand is higher than manufacturing and/or distribution ability, actual demand becomes limited. Otherwise, this is not an issue. Default is set to a high value to make this a non-issue.	
26	Availability of the New Product Units: Unit/Year Availability of the New Product in the marketplace can affect the demand. If real demand is higher than manufacturing and/or distribution ability, actual demand becomes limited. Otherwise, this is not an issue. Default is set to a high value to make this a non-issue.	
27	Availability of Your Existing Product Units: Unit/Year Availability of Your Existing Product in the marketplace can affect the demand. If real demand is higher than manufacturing and/or distribution ability, actual demand becomes limited. Otherwise, this is not an issue. Default is set to a high value to make this a non-issue.	

4. Cost

Data related to cost of the new product.

No.	Input, Unit & Description	Value
28	Initial Unit Cost Units: Dollar/Unit Initial unit cost assessed on the New Product - should include all costs (manufacturing, sales, service, etc.).	
29	Table of Percentage Cost Reduction as a Function of Sales Volume Units: Dimensionless As more and more units are manufactured, cost is reduced. This table shows a schedule of such cost reduction in terms of percentage.	

5. Pricing

Data related to pricing.

No.	Input, Unit & Description	Value
30	Desired Price Positioning Target Units: Dimensionless This represents the percentage for price premium or price lag for the new product compared to the market leader's price position. Range: -100% to +100%. Default is a premium of 10%. This is based strictly on a competitive price positioning strategy.	
31	Desired Profit Margin Units: Dimensionless Desired markup as percentage of unit cost. Default value in 35%.	
32	Market Leader's Unit Price Units: Dollar/Unit This is the market leader's unit price used as a benchmark for competitive pricing.	
33	Minimum Required Profit Margin Units: Dimensionless	
34	Sell Below Minimum Unit Price Policy Units: Dimensionless If sales below Minimum Unit Price is allowed, this variable should be set to 1; otherwise, it should be zero.	
35	Table for Effect of Market Share on the Indicated Unit Price Units: Dimensionless	
36	Table for Effect of Price Position on its Demand Units: Dimensionless	
37	Table for Effect of Relative Performance on the Indicated Unit Price Units: Dimensionless	
38	Table for Effect of Shortage or Surplus on the Indicated Unit Price Units: Dimensionless	
39	Table for Effect of Your Brand on Indicated Unit Price Units: Dimensionless	
40	Unit Price for the Competitor's Product Units: Dollar/Unit Average unit price charged for competitor's product sold.	

6. Performance

Data related to relative performance of existing and new products. The five performance criteria is user selectable.

No.	Input, Unit & Description	Value
41	<p>Performance Criterion 1 for the Competitor's Product</p> <p>Units: Dimensionless</p> <p>Considering the Competitors' Products, performance criterion 1 is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	
42	<p>Performance Criterion 1 for the New Product</p> <p>Units: Dimensionless</p> <p>Considering the New Product, performance criterion 1 is rated from 1 to 5, where 5 suggests that relative to competitive and existing products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	
43	<p>Performance Criterion 1 for Your Existing Product</p> <p>Units: Dimensionless</p> <p>Considering Your Existing Product, performance criterion 1 is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	
44	<p>Performance Criterion 2 for the Competitor's Product</p> <p>Units: Dimensionless</p> <p>Considering the Competitors' Products, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	
45	<p>Performance Criterion 2 for the New Product</p> <p>Units: Dimensionless</p> <p>Considering the New Product, performance criterion 2 is rated from 1 to 5, where 5 suggests that relative to competitive and existing products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	

No.	Input & Description	Value
46	<p>Performance Criterion 2 for Your Existing Product</p> <p>Units: Dimensionless</p> <p>Considering Your Existing Product, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	
47	<p>Performance Criterion 3 for the Competitor's Product</p> <p>Units: Dimensionless</p> <p>Considering the Competitors' Products, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	
48	<p>Performance Criterion 3 for the New Product</p> <p>Units: Dimensionless</p> <p>Considering the New Product, performance criterion 3 is rated from 1 to 5, where 5 suggests that relative to competitive and existing products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	
49	<p>Performance Criterion 3 for Your Existing Product</p> <p>Units: Dimensionless</p> <p>Considering Your Existing Product, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	
50	<p>Performance Criterion 4 for the Competitor's Product</p> <p>Units: Dimensionless</p> <p>Considering the Competitors' Products, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	

No.	Input & Description	Value
51	<p>Performance Criterion 4 for the New Product</p> <p>Units: Dimensionless</p> <p>Considering the New Product, performance criterion 4 is rated from 1 to 5, where 5 suggests that relative to competitive and existing products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	
52	<p>Performance Criterion 4 for Your Existing Product</p> <p>Units: Dimensionless</p> <p>Considering Your Existing Product, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	
53	<p>Performance Criterion 5 for the Competitor's Product</p> <p>Units: Dimensionless</p> <p>Considering the Competitors' Products, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	
54	<p>Performance Criterion 5 for the New Product</p> <p>Units: Dimensionless</p> <p>Considering the New Product, performance criterion 5 is rated from 1 to 5, where 5 suggests that relative to competitive and existing products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	
55	<p>Performance Criterion 5 for Your Existing Product</p> <p>Units: Dimensionless</p> <p>Considering Your Existing Product, this performance criterion is rated from 1 to 5, where 5 suggests that relative to competitive and new products, this performance criterion represents a Strong Advantage for the New Product for creating demand. Similarly, ratings of 4, 3, 2, and 1 suggest Moderate Advantage, Neutral, Moderate Disadvantage, and Strong Disadvantage, respectively. Default is 3 or Neutral.</p>	

No.	Input & Description	Value
56	Performance Lookup Table Units: Dimensionless For performance ratings of 5, 4, 3, 2, and 1, quantification values are 1.1, 1.05, 1.0, 0.95, and 0.9, respectively. These values may be changed for a more suitable set of values.	
57	Weight for Performance Criterion 1 Units: Dimensionless This is a measure of importance for Performance Criterion 1 as compared to other performance criteria. Default is 20% for equal rating for each of the five performance criteria.	
58	Weight for Performance Criterion 2 Units: Dimensionless This is a measure of importance for Performance Criterion 2 as compared to other performance criteria. Default is 20% for equal rating for each of the five performance criteria.	
59	Weight for Performance Criterion 3 Units: Dimensionless This is a measure of importance for Performance Criterion 3 as compared to other performance criteria. Default is 20% for equal rating for each of the five performance criteria.	
60	Weight for Performance Criterion 4 Units: Dimensionless This is a measure of importance for Performance Criterion 4 as compared to other performance criteria. Default is 20% for equal rating for each of the five performance criteria.	
61	Weight for Performance Criterion 5 Units: Dimensionless This is a measure of importance for Performance Criterion 5 as compared to other performance criteria. Default is 20% for equal rating for each of the five performance criteria.	

7. Brand

Data related to brand.

No.	Input, Unit & Description	Value
62	Percentage of the Market that Favors Your Company Brand Units: Dimensionless A number from 0 - 100 indicating the percentage of the market favorably recognizing your company's brand. Default is 40.	
63	Percentage of the Market that Favors Your Competitor's Brand Units: Dimensionless A number from 0 - 100 indicating the percentage of the market favorably recognizing competitor's brand. Default is 30.	
64	Table for Effect of Brand on Demand Units: Dimensionless This table should be adjusted according to user's discretion. The default table shows a linear effect of 0.75 to 1.25 for zero percent brand recognition to 100 percent brand recognition, respectively. Note that at 50 percent, where possibly both your brand and competitor's brand may be favorably recognized equally high, the effect is 1 (no effect on demand).	

8. Risk

Data related to risk.

No.	Input, Unit & Description	Value
65	<p>New Technology Rated for its Ability to be Delivered to Market On Time</p> <p>Units: Dimensionless</p> <p>Select a rating from 0 to 100, where 100 indicates 100 percent confidence that the new technology can be manufactured in a cost effective way. Default value for this variable is 100.</p>	
66	<p>New Technology Rated for its Newness in Technical Sense</p> <p>Units: Dimensionless</p> <p>Select a rating from 0 to 100, where 100 indicates 100 percent confidence that the new technology has a proven technical track. Note the reverse rating. Default value for this variable is 100.</p>	
67	<p>New Technology Rated for its Newness to Any Market</p> <p>Units: Dimensionless</p> <p>Select a rating from 0 to 100, where 100 indicates 100 percent confidence that the new technology has been proven in at least one other market. Note the reverse rating. Default value for this variable is 100.</p>	
68	<p>New Technology Rated for its Newness to Targeted Market</p> <p>Units: Dimensionless</p> <p>Select a rating from 0 to 100, where 100 indicates 100 percent confidence that the new technology has been proven in the targeted market. Note the reverse rating. Default value for this variable is 100.</p>	
69	<p>Was There a Successful Feasibility Test Performed on this New Technology as a Measure of Reliability</p> <p>Units: Dimensionless</p> <p>Select a rating from 0 to 100, where 100 indicates 100 percent confidence that the new technology has been found completely feasible. Default value for this variable is 100.</p>	
70	<p>Weight for a Successful Feasibility Test</p> <p>Units: Dimensionless</p> <p>This value is used as a weight for the variable "Was There a Successful Feasibility Test Performed on this New Technology?" It indicates the relative importance of this variable compared to other variables used for quantifying risk. Default value for this variable is 0.2. Acceptable range is from 0 to 1. Note that all weights for risk variables have to add up to 1.</p>	

No.	Input & Description	Value
71	<p>Weight for Ability to be Delivered to Market On Time</p> <p>Units: Dimensionless</p> <p>This value is used as a weight for the variable "New Technology Rated for its Ability to be Delivered to Market On Time". It indicates the relative importance of this variable compared to other variables used for quantifying risk. Default value for this variable is 0.2. Acceptable range is from 0 to 1. Note that all weights for risk variables have to add up to 1.</p>	
72	<p>Weight for Newness in All Markets</p> <p>Units: Dimensionless</p> <p>This value is used as a weight for the variable "New Technology Rated for its Newness to Any Market". It indicates the relative importance of this variable compared to other variables used for quantifying risk. Default value for this variable is 0.2. Acceptable range is from 0 to 1. Note that all weights for risk variables have to add up to 1.</p>	
73	<p>Weight for Target Market Newness</p> <p>Units: Dimensionless</p> <p>This value is used as a weight for the variable "New Technology Rated for its Newness to Targeted Market". It indicates the relative importance of this variable compared to other variables used for quantifying risk. Default value for this variable is 0.2. Acceptable range is from 0 to 1. Note that all weights for risk variables have to add up to 1.</p>	
74	<p>Weight for Technical Newness</p> <p>Units: Dimensionless</p> <p>This value is used as a weight for the variable "New Technology Rated for its Newness in Technical Sense". It indicates the relative importance of this variable compared to other variables used for quantifying risk. Default value for this variable is 0.2. Acceptable range is from 0 to 1. Note that all weights for risk variables have to add up to 1.</p>	

9. Switching Cost

Data related to switching cost.

No.	Input, Unit & Description	Value
75	Indirect Costs and Risk of Switching Units: Dimensionless A number between 0 and 10, where 0 represents no indirect cost and no risk in switching from an old product to the New Product, and 10 represents very high indirect costs and very high risks. Such indirect costs and risks are associated with possible loss of productivity during switching which may result in loss of customers and/or sales for the end-user. Many factors contribute to this cost and most of them are very subtle. For example, the New Product may require a different workflow or method of production that may not be necessarily obvious. Default value is 1.	
76	Minimum Direct Costs as Percent of Unit Price Units: Dimensionless Direct Costs include costs associated with installation of the New Product, removal of any old products, training costs, etc. it is measured against Unit price of the New Product. Default value is 30% which is assumed to be reasonable and have no affect on demand. This value may be changed as required.	
77	Opportunity Cost of Not Switching Units: Dimensionless A number between 0 and 10, where 0 represents no opportunity cost if end-user does not switch from an old product to the New Product, and 10 represents a very high opportunity cost. Default value is 0.	
78	Table for Adverse Effect on Demand Based on Switching Cost of the New Product Units: Dimensionless	
79	Table to Determine Contribution of Indirect Costs on Switching Cost Units: Dimensionless This table determines the contribution of indirect costs or risk of switching. If indirect costs are rated 1, the contribution is null. Below 1, an end-user finds it encouraging to switch. However, as the rating increases above 1, an end-user is increasingly discouraged to switch.	
80	Table to Determine Contribution of Minimum Direct Costs on Switching Cost Units: Dimensionless This table determines the contribution that direct costs have on the total switching cost. If direct costs are 30% of the unit price of the New Product, it has no affect. Below 30%, it has positive affect; meaning that direct costs of less than 30% of the unit price help an end-user to switch. However, as direct costs rise above 30%, an end-user gets discouraged to switch.	

No.	Input & Description	Value
81	<p>Table to Determine Contribution of Opportunity Cost on Switching Cost</p> <p>Units: Dimensionless</p> <p>This table determines the contribution of opportunity cost of not switching. If opportunity cost is rated 0, the contribution is null. As the rating increases above 1, an end-user is increasingly encouraged to switch to avoid increasing cost of opportunity.</p>	

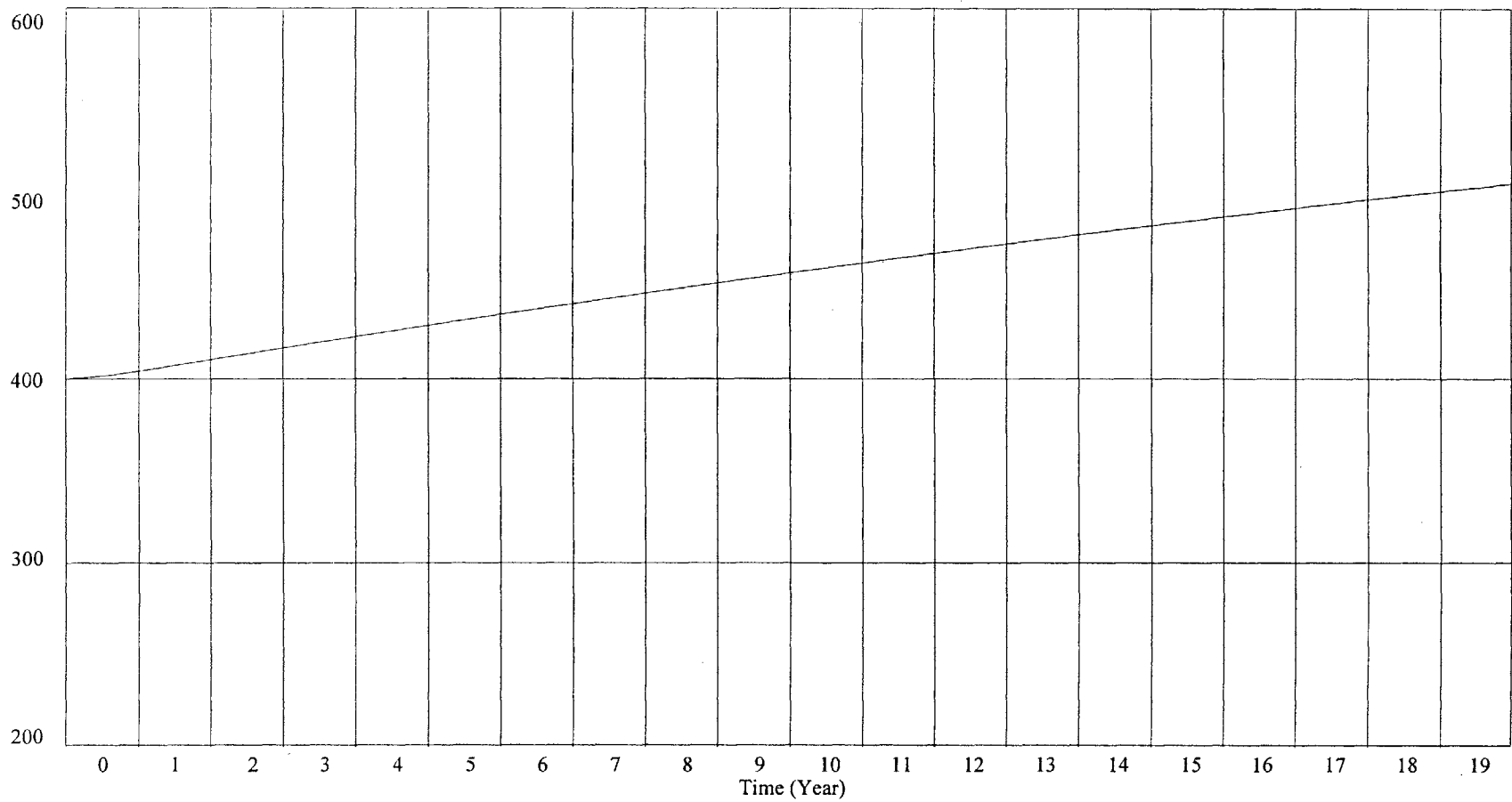
10. Net Present Value Calculation

Data used to calculate NPV.

No.	Input, Unit & Description	Value
82	Discount Rate Units: Dimensionless	
83	Margins on Additional Products and Services Sold per New Product Unit Units: Dollar/Unit	
84	Past Sales of Competitor's Product Units: Unit This is the initial value for installed base portion made up of the competitor's products.	
85	Past Sales of Other Products Units: Unit	
86	Past Sales of Your Existing Product Units: Unit	
87	Present Value of Capital Investments Related to Sales of Additional Products and Services Units: Dimensionless This represents the present value of all investments related to the new product that leads to sales of additional products and services.	
88	Present Value of the New Product Commercialization and Other Capital Investments Units: Dimensionless	

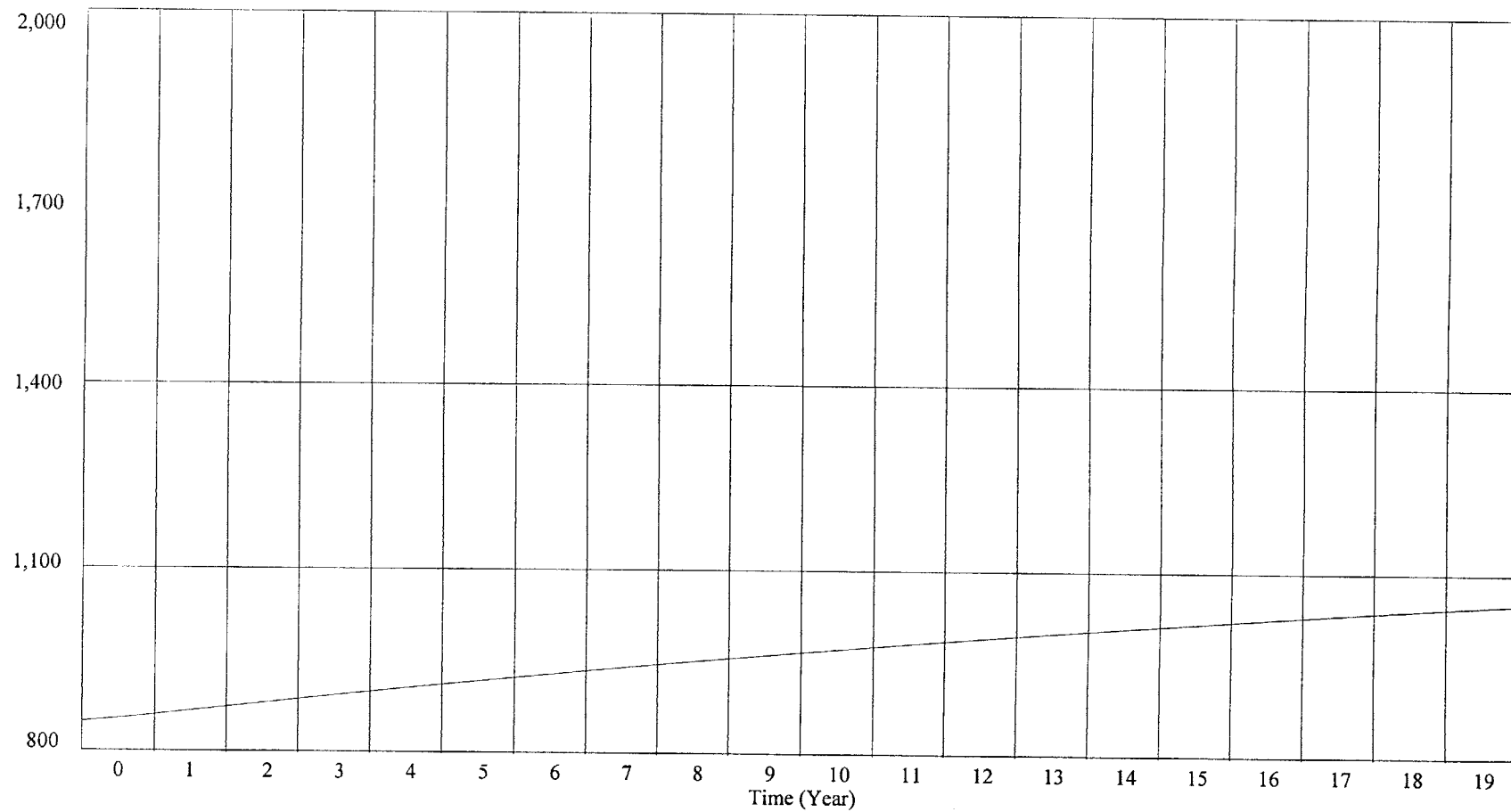
APPENDIX D -- TEST CASE RESULTS

This section includes 11 graphs indicating the result of the simulations performed in conjunction to the test case.



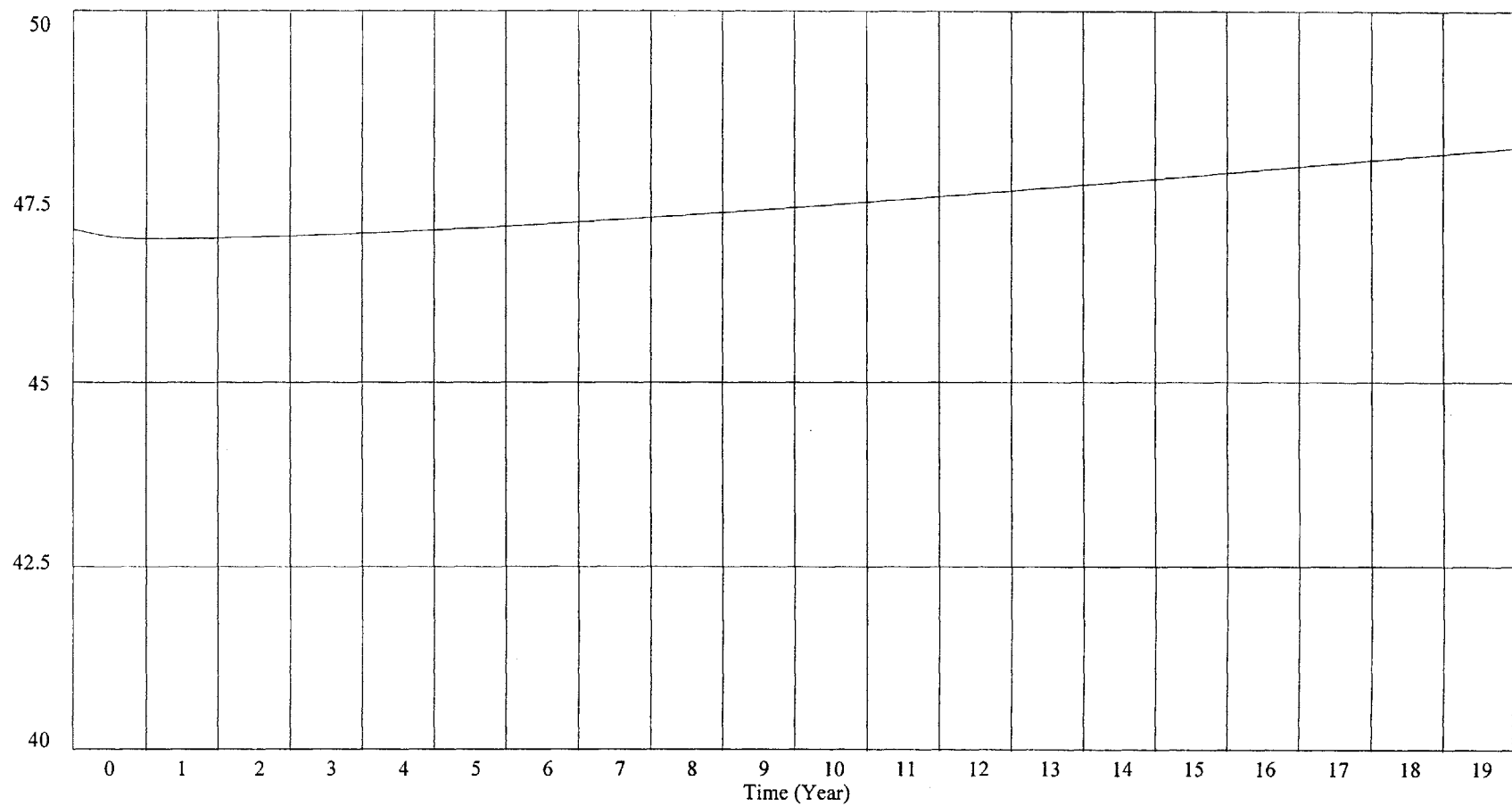
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Figure D - 1. Graph for Your Installed Base



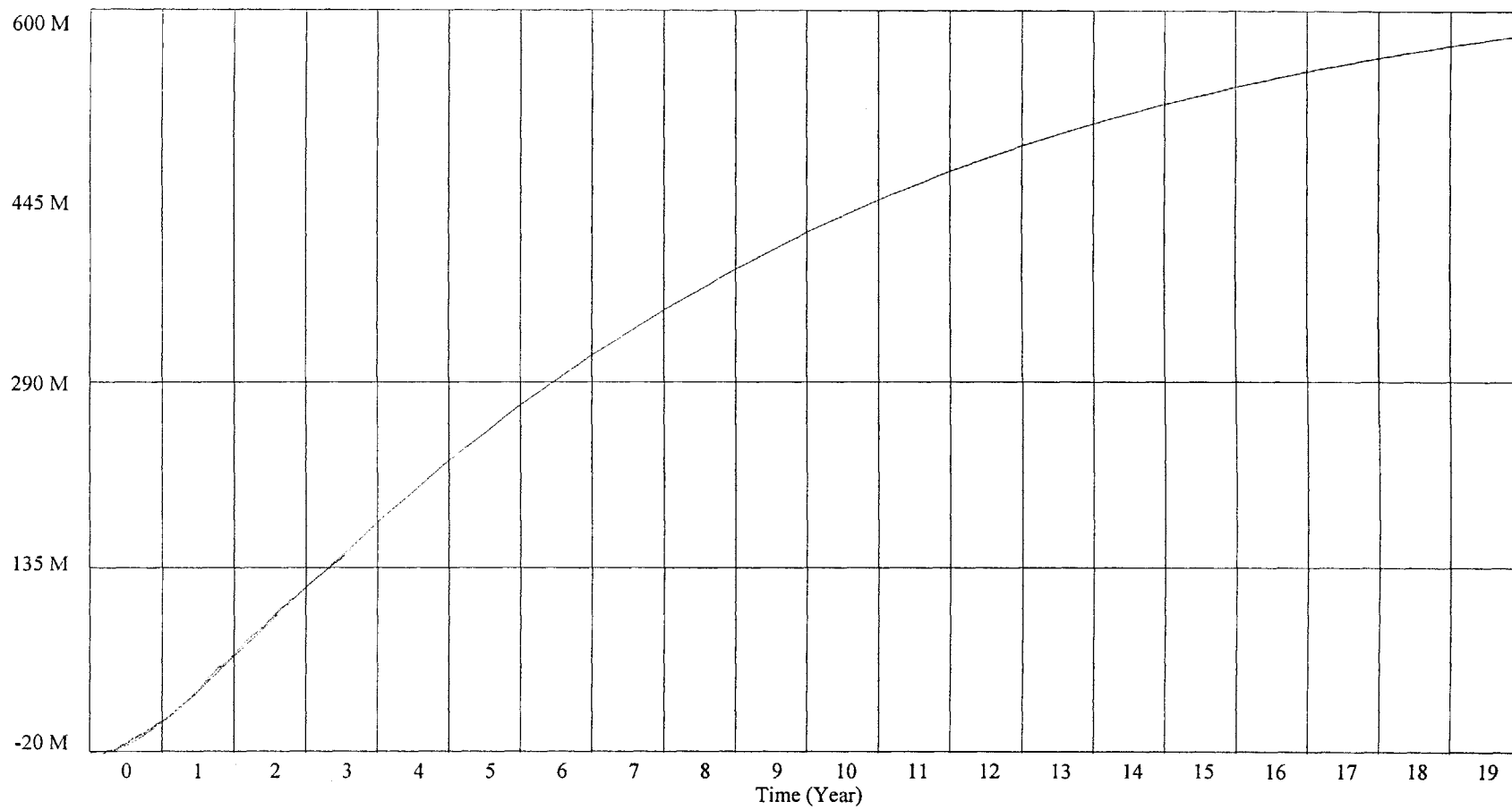
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Figure D - 2. Graph for Installed Base



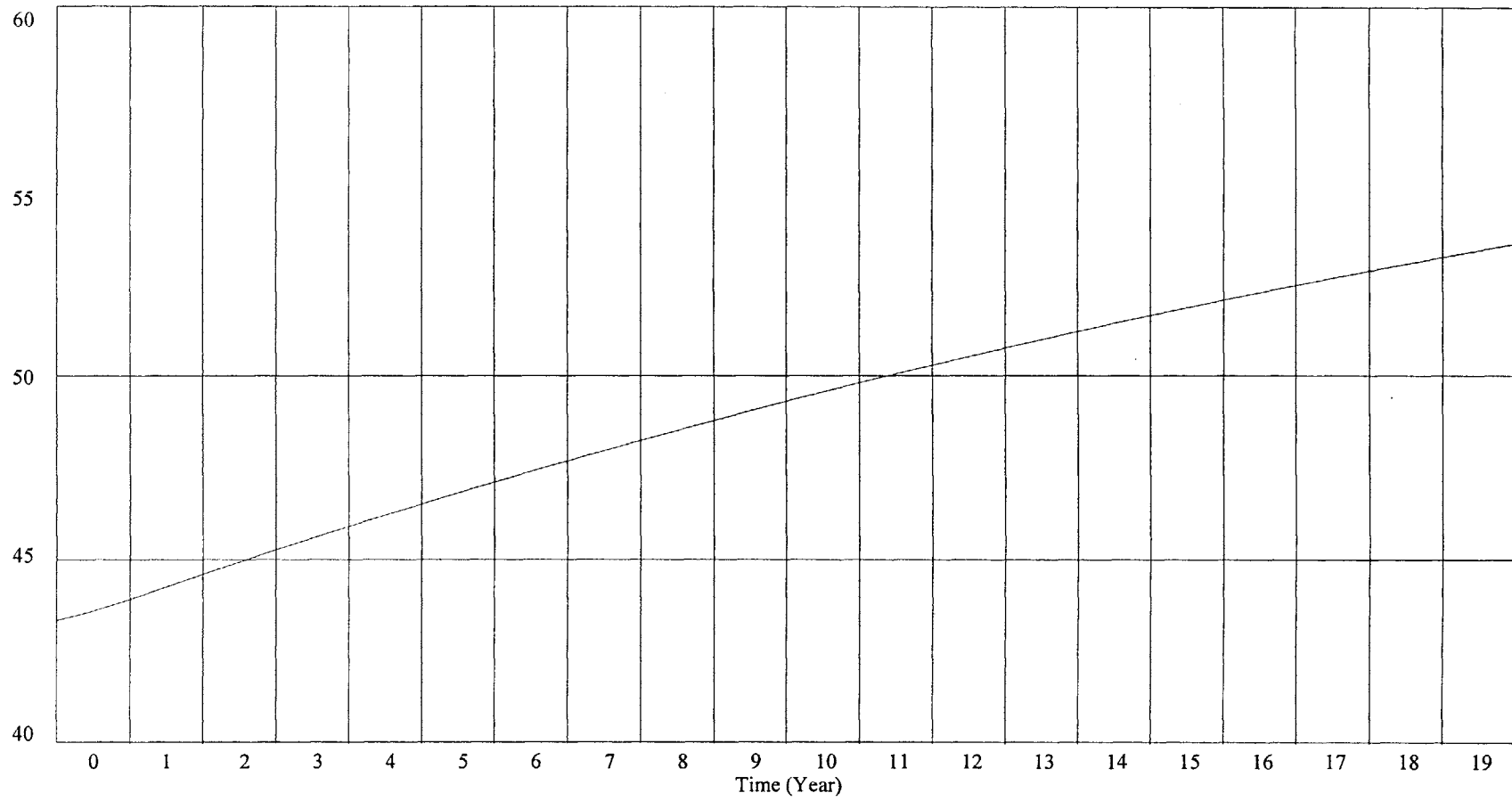
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Figure D - 3. Graph for Market Share



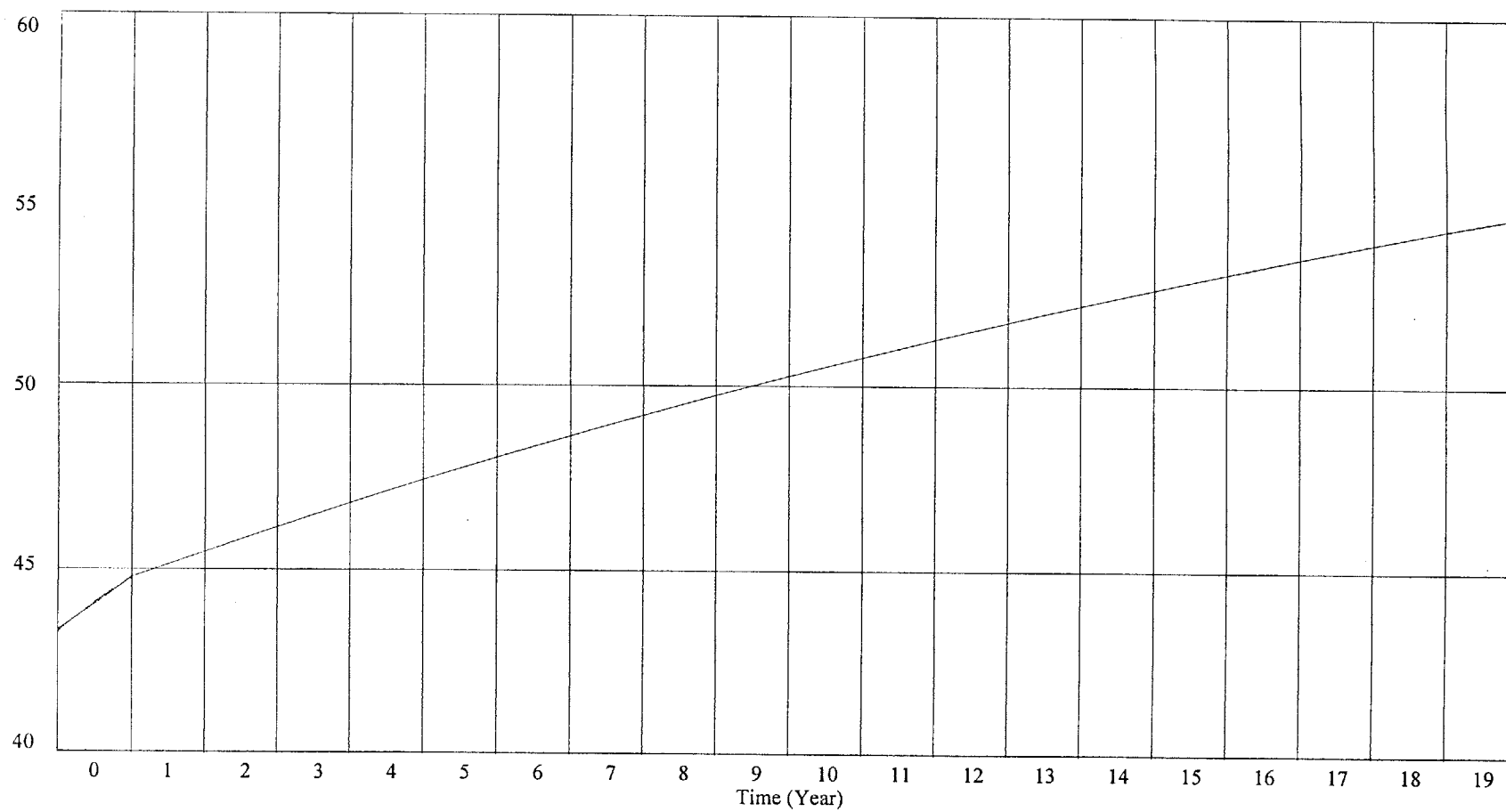
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Figure D - 4. Graph for NPV for the New Product



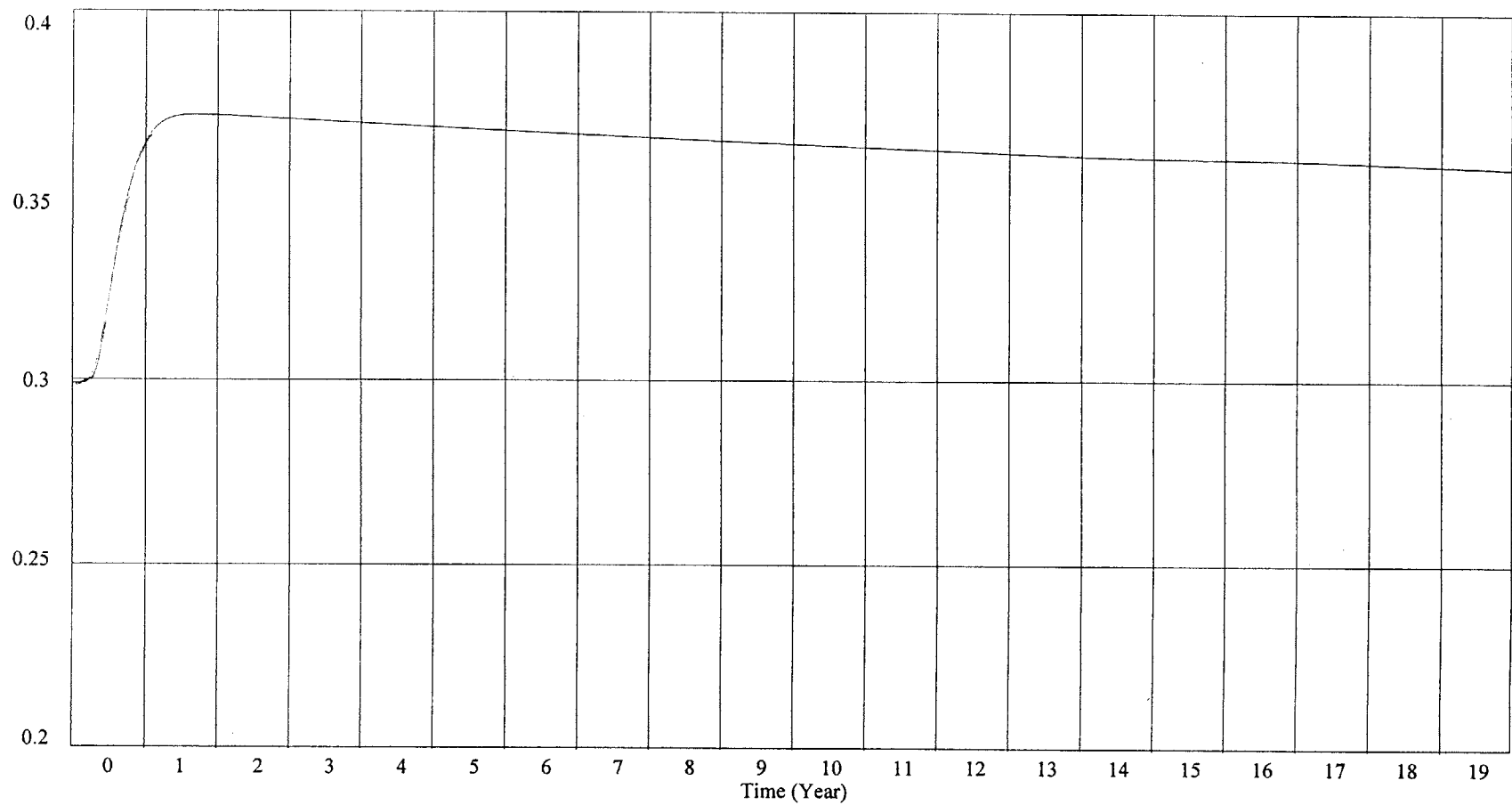
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Figure D - 5. Graph for Potential Demand



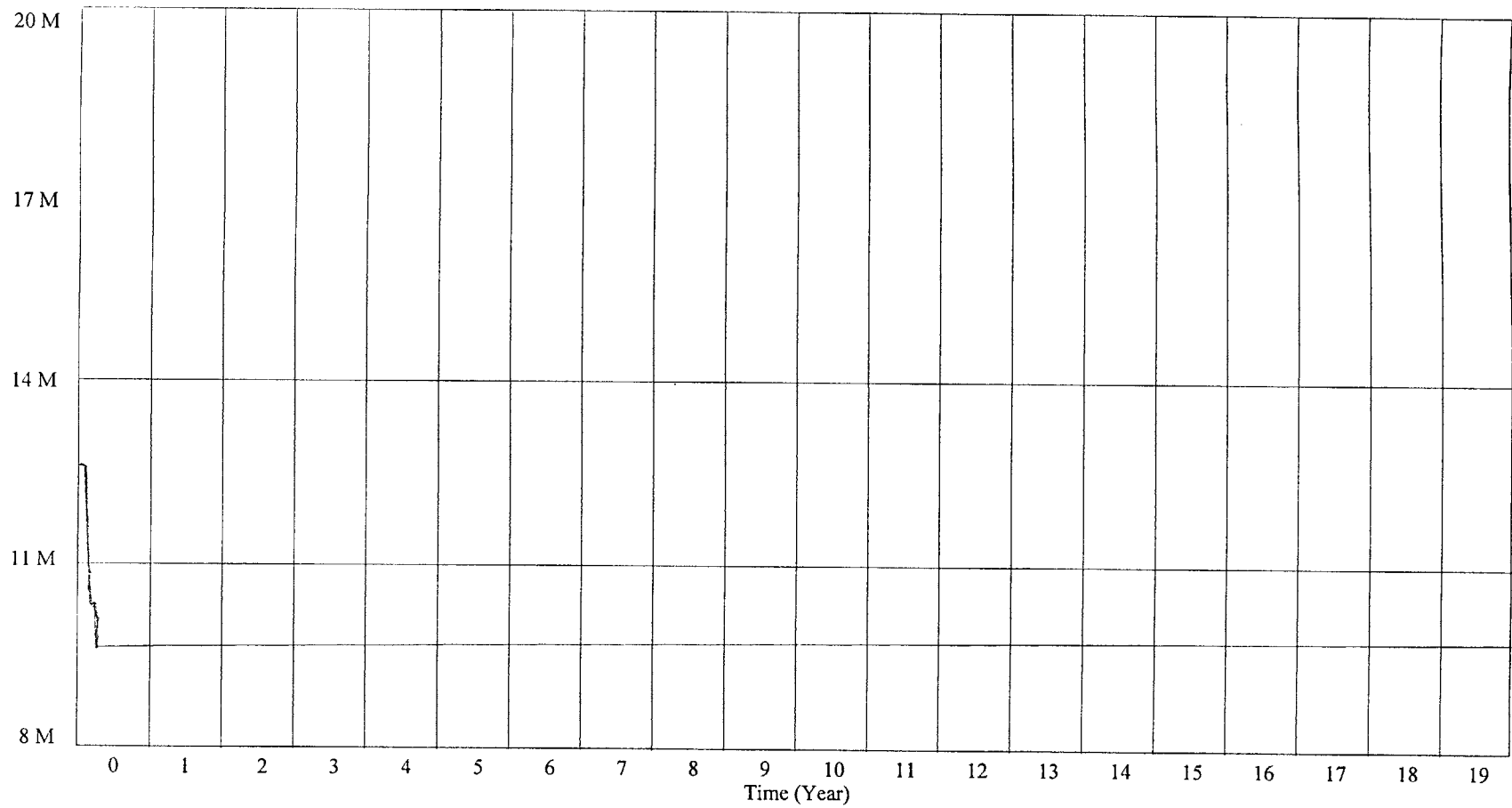
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Figure D - 6. Graph for Potential Demand for the New Product



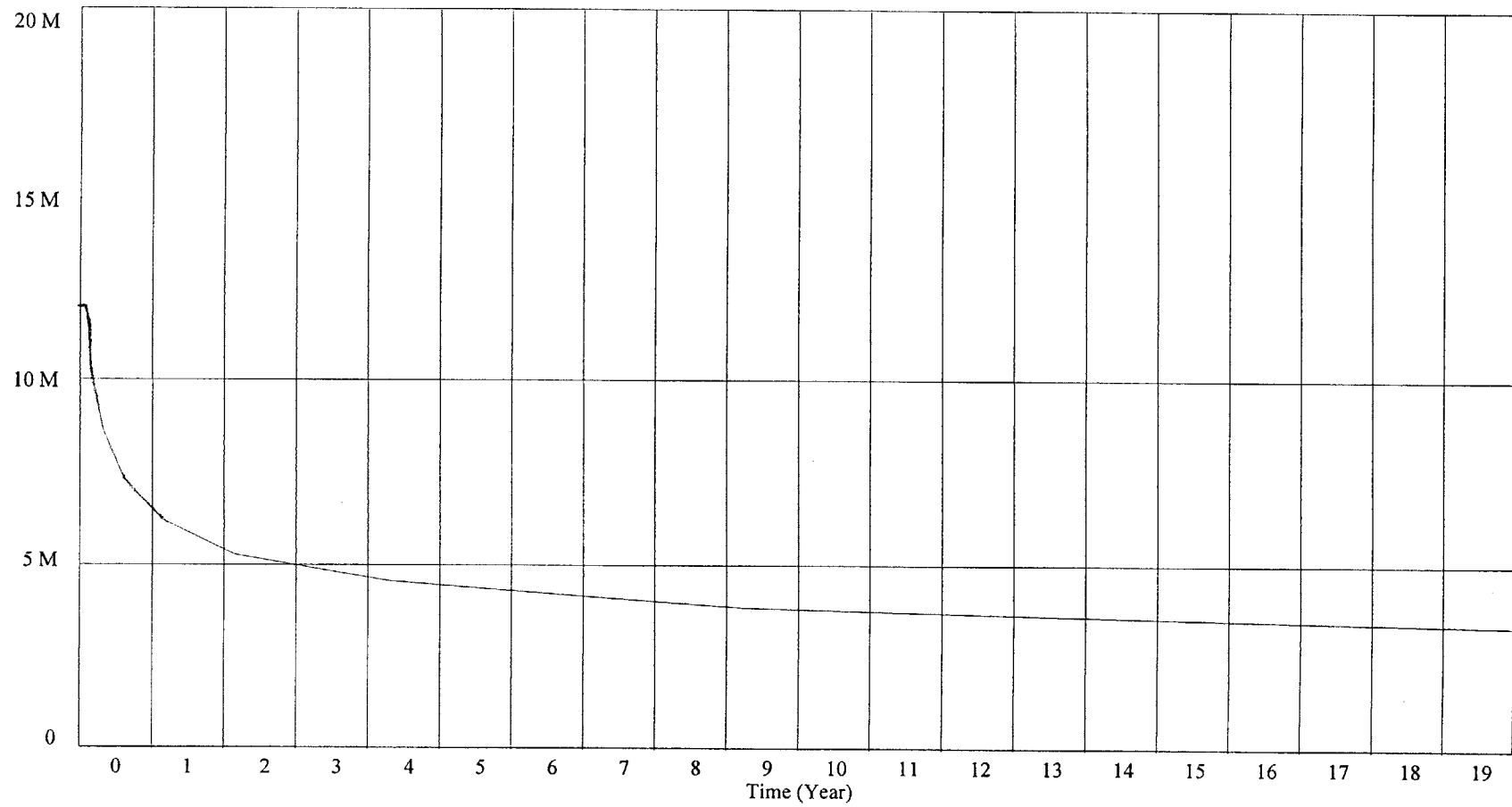
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Figure D -7. Graph for Total Adjusted Effects for the New Product



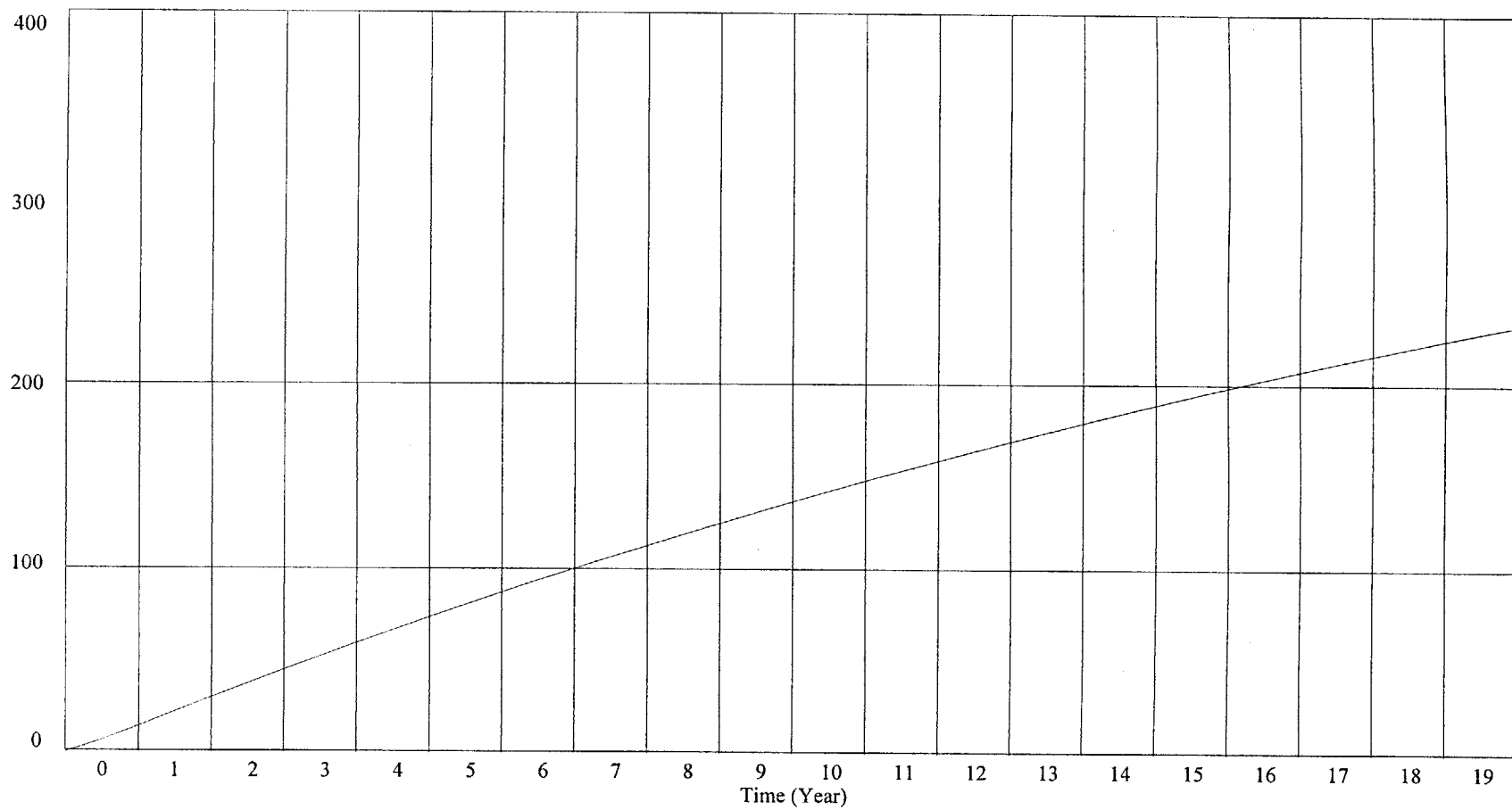
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Figure D - 8. Graph for Unit Price for the New Product



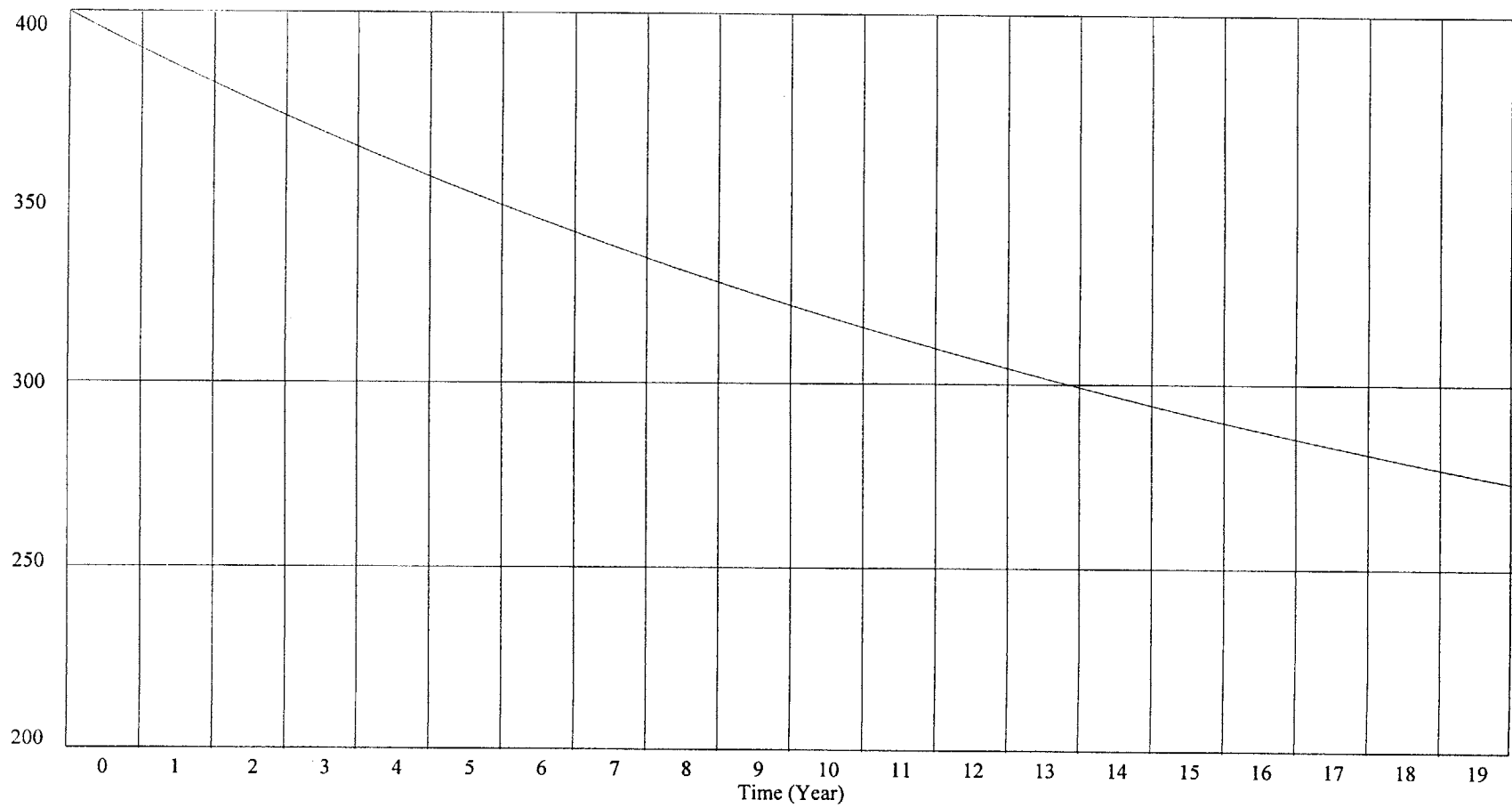
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Figure D - 9. Graph for Unit Cost for the New Product



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Figure D - 10. Graph for Installed Base for the New Product



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Figure D - 11. Graph for Installed Base for Your Existing Product

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